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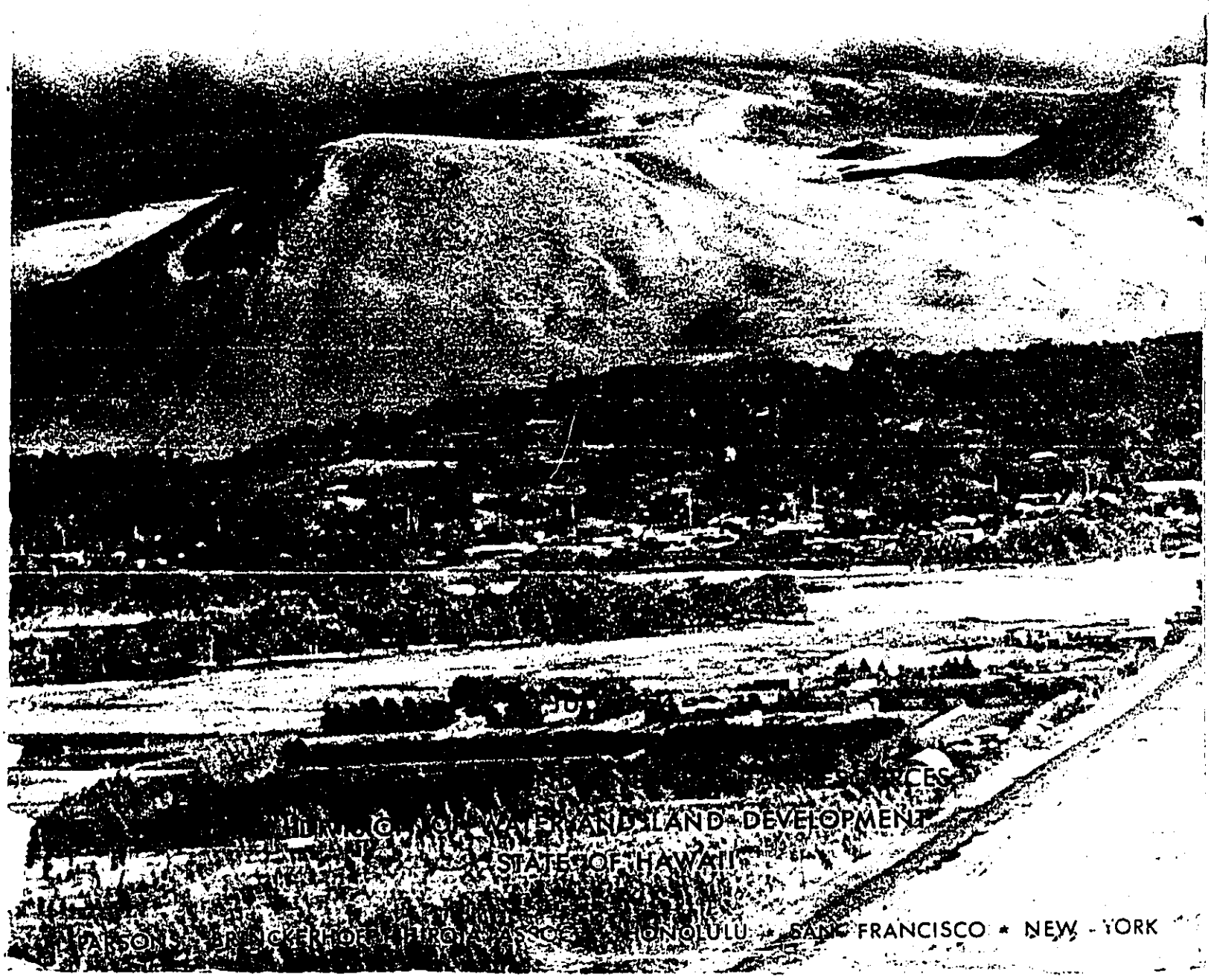
ENVIRONMENTAL IMPACT STATEMENT

KOHAKOHAU DAM PROJECT

SOUTH KOHALA WATER PROJECT
ISLAND OF HAWAII



DEPT. OF LAND AND NATURAL RESOURCES
DIV. OF WATER AND LAND DEVELOPMENT
STATE OF HAWAII

PARSONS, BRINCKERHOFF, HALL & MACDONALD
HONOLULU * SAN FRANCISCO * NEW YORK

COVER PHOTO:

The town of Waimea, Island of Hawaii and the Kohala foothills as seen from above the Kamuela Airport

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ENVIRONMENTAL IMPACT STATEMENT

KOHAKOHAU DAM PROJECT

SOUTH KOHALA DISTRICT

ISLAND OF HAWAII

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

DIVISION OF WATER AND LAND DEVELOPMENT

JULY, 1974

PARSONS BRINCKERHOFF-HIROTA ASSOCIATES

700 BISHOP STREET - SUITE 712 - HONOLULU, HAWAII

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ENVIRONMENTAL IMPACT STATEMENT

KOHAKOHAU DAM PROJECT

SUMMARY STATEMENT

I. Project Background and Description: In 1964 the State of Hawaii, Department of Land and Natural Resources, Division of Water and Land Development (DOWALD), and the County of Hawaii Department of Water Supply, made a study of the public water system in the South Kohala-Hamakua Region and outlined a water development program that would better meet the area's future water needs. Over the ensuing years, various elements of the program were implemented, including the construction of supply works, storage reservoirs, and an expanded treatment plant. In the study, the impoundment of Kohakohau streamwaters by a dam was proposed as a future measure. In 1970, the State Division of Water and Land Development completed a study supporting the engineering feasibility of constructing such a dam and reservoir. As currently proposed, the Kohakohau Dam Project would be located at approximate elevation 3,700 feet on the Kohakohau Stream near Waimea, Hawaii. The project would consist of a rock-fill dam and attendant structures to impound Kohakohau Stream waters for domestic uses. As a part of the Waimea-Kawaihae-Puukapu system of water supply facilities, the components of the Kohakohau Dam project would be owned and operated by the County of Hawaii Department of Water Supply upon completion. The project could be constructed in two alternate stages: (1) ultimate development, resulting in an expected yield of 10 mgd, and (2) initial development, resulting in an expected yield of 5 mgd. The initial development stage could later be expanded to the ultimate capacity.

II. Existing Environment: The study area comprises a gross area of approximately 1,000 acres, located within the Kohala Watershed Reserve and the Kohala Forest Reserve. Public access to the area is currently limited to entries for official purposes. The proposed facilities lie in a middle elevation, wet forest characterized by sparse growths of tree ferns, shrubs, and stunted trees. No rare or endangered plants are found in the area. Wildlife populations are generally small and are common to the islands, with the exception of the Koloa (a native duck). Two Koloas, the only species considered rare or endangered, were observed passing over the study area. There is no appreciable aquatic life in Kohakohau Stream. The area is believed to be too wet and high in elevation to have been devoted to ancient

agriculture or other uses and exhibits no historic or archaeologic sites today. Air quality and noise levels in the study area are virtually unaffected by human activities. Kohakohau Stream waters generally exhibit high physical and chemical qualities with the exception of occasional high color and peaty taste. Intermittant flooding occurs during intense rainfall periods, but downstream damage has been minimal. The study area is located in a Zone III seismicity area (as is the entire island of Hawaii) and is comparable to the seismically active area of Southern California. The South Kohala-Hamakua region of the island of Hawaii exhibits a decentralized distribution of population and land use. Population in the combined districts has increased since 1970, reversing the declining trend of the period 1920 to 1970. The economy of the region is partially dominated by agriculture.

III. Future Environment Without the Project: No significant changes in physical and environmental characteristics of the project study area are expected without the Kohakohau Dam Project. Anticipated changes in socio-economic conditions include a growth in population and economic activity in the region and primarily in the South Kohala District. Projections indicate substantial future resort, residential, and commercial growth in the area and primarily along the South Kohala coastline, which is expected to spur economic activity and shift labor and income away from agricultural patterns. Existing water supplies will be insufficient to meet expected increasing demands within the near future.

IV. Impact of the Kohakohau Dam Project: The Kohakohau Dam Project will inundate approximately 120 or 80 acres of middle elevation, wet forest and will provide an estimated 10 or 5 million gallons per day of potable water for South Kohala and Hamakua, depending upon development stage of the project. Construction, access, and quarry areas will sustain surface damage but will revegetate. Habitat areas for a small population of birds and mammals will be disturbed, but relocation of the species to surrounding areas will occur. An increase in wet land habitat for the Koloa (endangered duck species) will be provided. Intermittent flooding on Kohakohau Stream will be minimized. Less than 1 per cent of the total area of the Kohala Forest Reserve will be changed from the existing condition. Although the natural visual character of 3,000 to 4,000 feet of the Kohakohau Stream system will be lost to inundation, only a negligible impact to the visual quality of the Kohala slopes and foothills will result from proposed facilities. No historic or archaeologic sites will be affected by the project. Air pollution and noise levels in the study area will increase moderately during the construction period. Kohakohau Stream waters will exhibit a temporary increase in turbidity and solids concentrations, and flows below the dam will be attenuated and probably reduced upon completion of facilities. The safety of the proposed Kohakohau Dam under

earthquake loading was analyzed, indicating that under the most critical and improbable possible conditions (i.e., maximum potential earthquake with a full reservoir, resulting in settlement of the dam and cracking of the impervious concrete membrane), the estimated leakage from the reservoir would not erode or displace the rockfill dam and would correspond to the maximum probable flow of Kohakohau Stream from which no appreciable downstream damage will result. The Kohakohau Dam Project will provide a significant increase in the available domestic water supply in South Kohala and Hamakua, which may result in a slight acceleration in expected residential, commercial, and resort development in the region. A small number of jobs may be created for local workers, and a short-term surge in local economic activity will result from the work force during construction of the project. Potential hydroelectric generation facilities may result in slightly reduced power rates in the region.

V. Unavoidable Adverse Impacts: Adverse impacts expected to be unavoidable with available preventative and remedial measures include temporary surface damages by excavation and stripping which will be minimized in the long-term by revegetation, loss of up to 4,000 feet of the Kohakonau Stream system by inundation, temporary reductions in air and water qualities during construction, and potential reduction in stream flows below the dam. Minimal adverse effects will include the slight visual intrusion of proposed facilities and the conversion of a small area of the Kohala Forest and Watershed Reserve acreages to an accessory use.

VI. Alternatives to the Kohakohau Dam Project: Five alternatives considered to have potential engineering, economic, and environmental feasibility in meeting the objectives of the Kohakohau Dam Project were investigated. They are: (1) high-level ground water, (2) low-level ground water, (3) surface water, (4) desalination and (5) successive use of existing water supplies. In addition, the alternative of no action was considered. In summary, other alternatives exhibit high exploration and development costs or offer unknown or unreliable yields in comparison with the Kohakohau Dam Project. The no-action alternative would necessitate the public or private development of localized and incremental water supplies where water is available and would result in insufficient supplies in water-lacking areas. The Kohakohau Dam Project offers the most reliable and economical, and the least damaging, alternative for the provision of additional domestic waters in the South Kohala-Hamakua region. The potential benefit of hydroelectric power generation associated with the project could be significant.

VII. Comments on the Draft Environmental Impact Statement:

(To be completed.)

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ENVIRONMENTAL IMPACT STATEMENT
KOHAKOHAU DAM PROJECT, SOUTH KOHALA, HAWAII

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DRAFT ENVIRONMENTAL IMPACT STATEMENT

KOHAKOHAU DAM PROJECT

INTRODUCTION

In the early 1960's domestic water supplies in South Kohala and Hamakua were troubled with problems of droughts and poor qualities of color and taste. Recognizing the development potential of South Kohala, and anticipating future domestic water requirements in the area, the Department of Land and Natural Resources, Division of Water and Land Development, studied potential water supply sources and systems for the South Kohala and Hamakua Districts and prepared recommendations for the development of identified water resources to alleviate existing problems and meet projected demands. 1/ In 1965, the Department of Land and Natural Resources completed A Water Development Plan for South Kohala - Hamakua 2/ which outlined a program of specific actions to provide a reliable and adequate system for domestic water supply in South Kohala. Many of the proposed facilities have been completed and are now operated by the County of Hawaii Department of Water Supply. Among the measures suggested to meet future water demands was the development of an impoundment on Kohakohau Stream, which had received previous attention and investigation. In 1970 the Department of Land and Natural Resources, Division of Water and Land Development completed a report 3/ supporting the engineering

1/ Reference 34.
2/ Reference 31.
3/ Reference 36.

feasibility of constructing a dam and reservoir on the Kohakohau Stream above Waimea, Hawaii. The project would impound waters from the Kohakohau and Alakahi Streams for use in the South Kohala and Hamakua Districts.

This environmental impact statement has been prepared to investigate and assess potential environmental effects of the Kohakohau Dam Project. In addition, it documents comments and concerns expressed by interested parties during the course of the environmental impact studies. This statement is submitted in compliance with the National Environmental Policy Act of 1969 (NEPA) 4/, the Executive Order, August 23, 1971 5/ of the Governor of Hawaii, and the guidelines presented in the Draft Manual for the Preparation and Processing of Environmental Impact Statements 6/ of the State of Hawaii.

4/ Reference 67.
5/ Reference 48.
6/ Reference 47.

I. PROJECT IDENTIFICATION

1 - Project Location

The project is located in the South Kohala District of the island of Hawaii, State of Hawaii, the largest and southernmost island in the Hawaiian Archipelago (see Figures 1 and 2). As shown in Figure 3, the Kohakohau Stream flows from near the summit of the Kohala Mountains southeastward toward the town of Waimea and then westward to the Pacific Ocean. The gross project study area, as shown in Figure 4, encompasses an area of about 1,000 acres and is located approximately one to three miles north-northwest of the Waimea town boundary and primarily within lands owned or held by the State of Hawaii.

As shown in Figure 4, the project study area is located within the Kohala Watershed Reserve of the Kohala Forest Reserve and within a proposed "protective subzone" of a State of Hawaii conservation district 7/ . As a restricted watershed, the area is accessible only by special permit in accordance with requirements designated by the Department of Health. As a portion of a proposed "protective subzone" of a state conservation district, the area would be reserved for designated uses intended to protect natural areas such as restricted watersheds, fish and wildlife sanctuaries, natural reserves, and significant historic and archaeologic sites. Permitted conditional uses would include the development of water collection, pumping, storage, and transmission facilities. These conditional uses would be governed

7/ As defined in Reference 40.

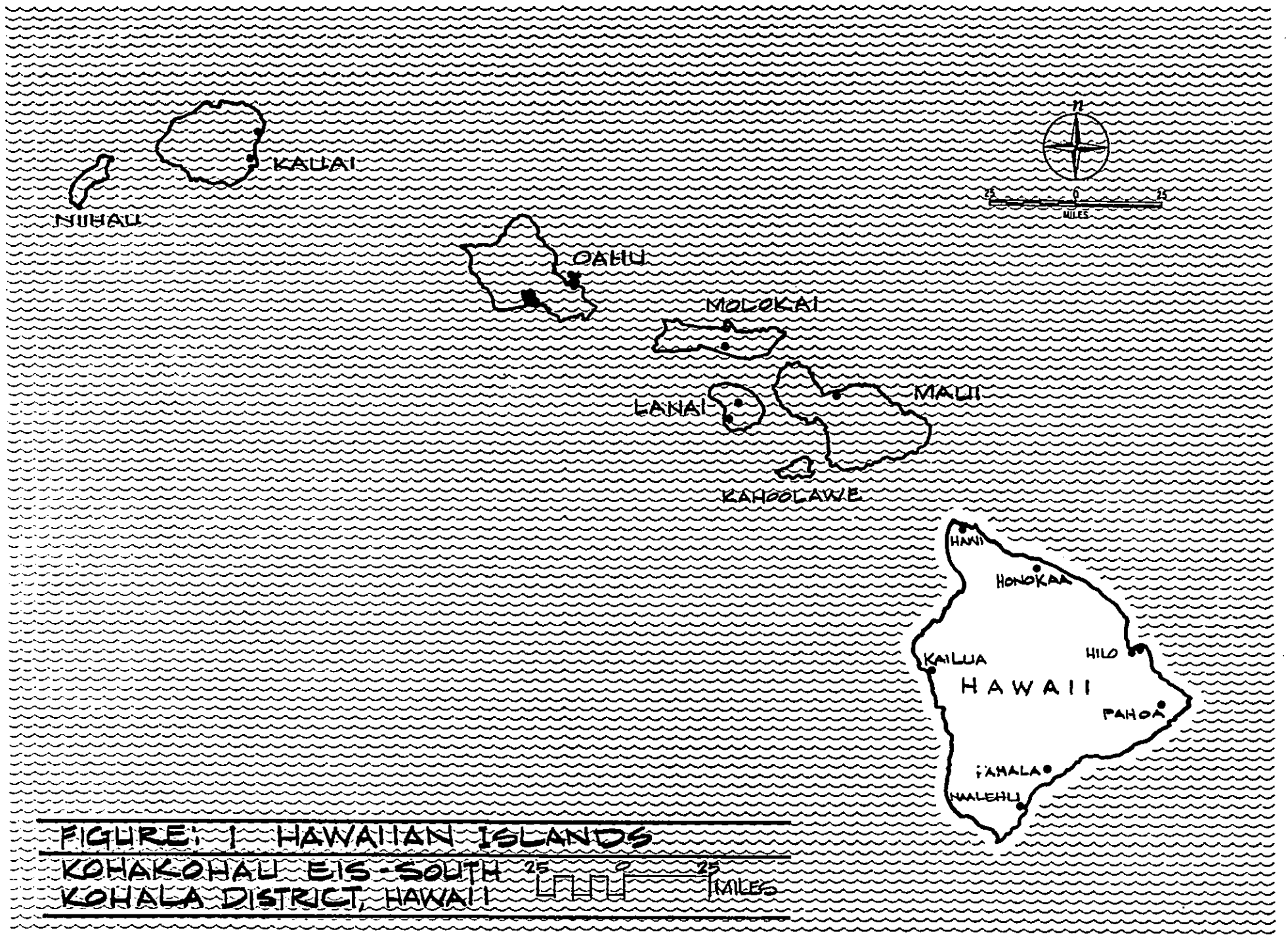


FIGURE: 1 HAWAIIAN ISLANDS
KOHAKOHAU EIS - SOUTH KOHALA DISTRICT, HAWAII

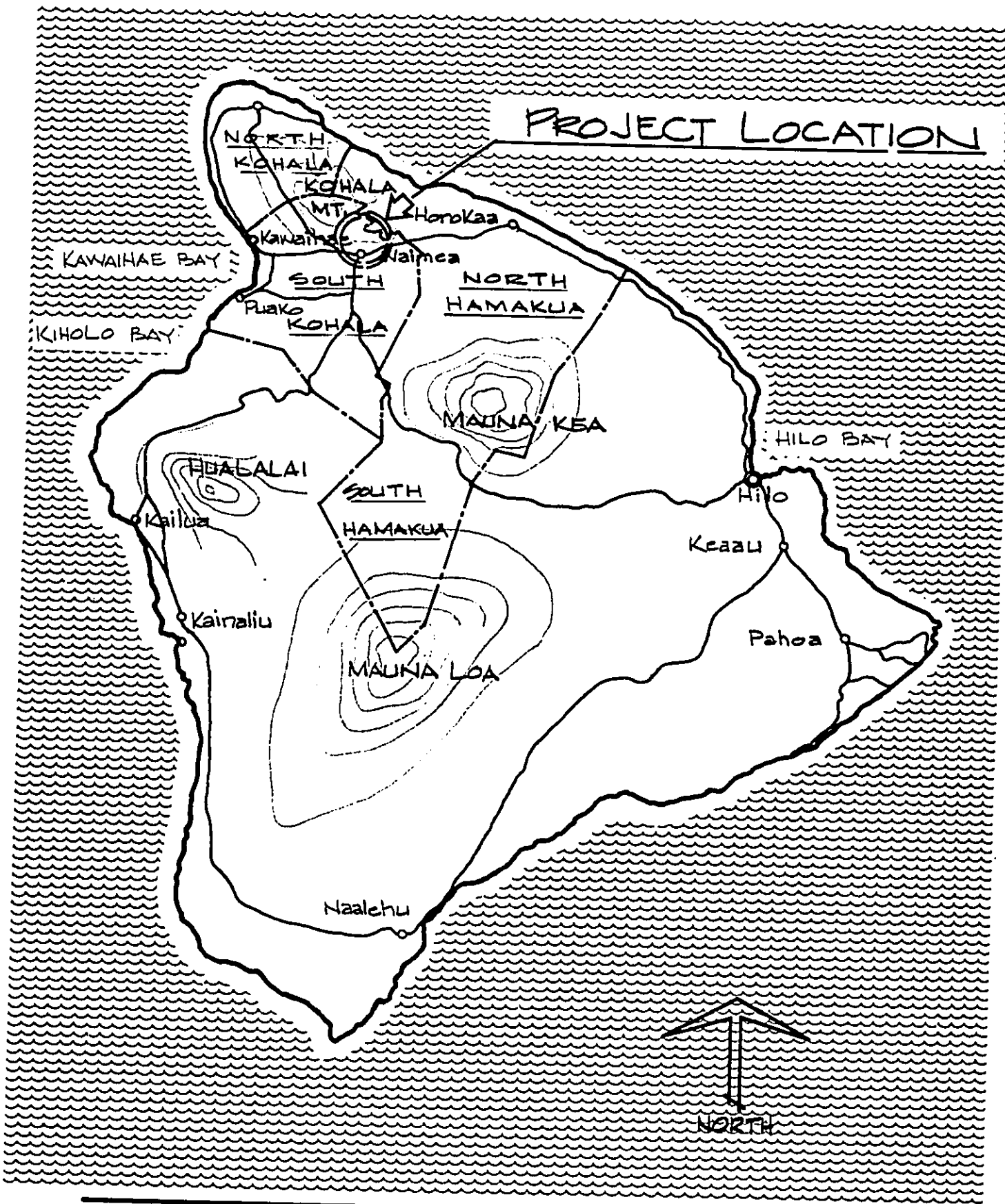


FIGURE : 2 ISLAND OF HAWAII

KOHAKOHAU EIS - SOUTH
KOHALA DISTRICT, HAWAII

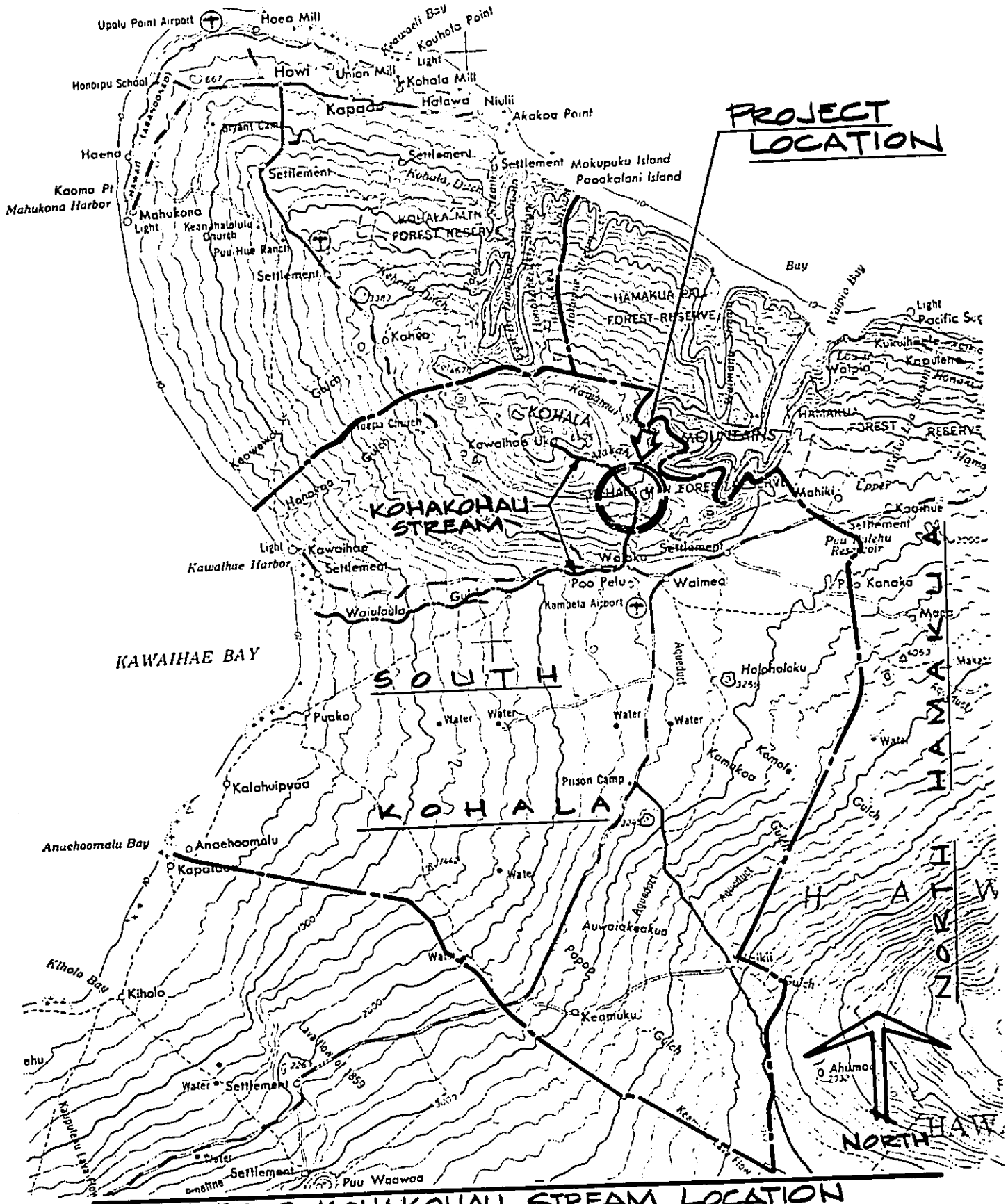


FIGURE: 3 KOHAKOHAU STREAM LOCATION

KOHAKOHAU EIS - SOUTH
KOHALA DISTRICT, HAWAII

2 0 2 4 6 MILES

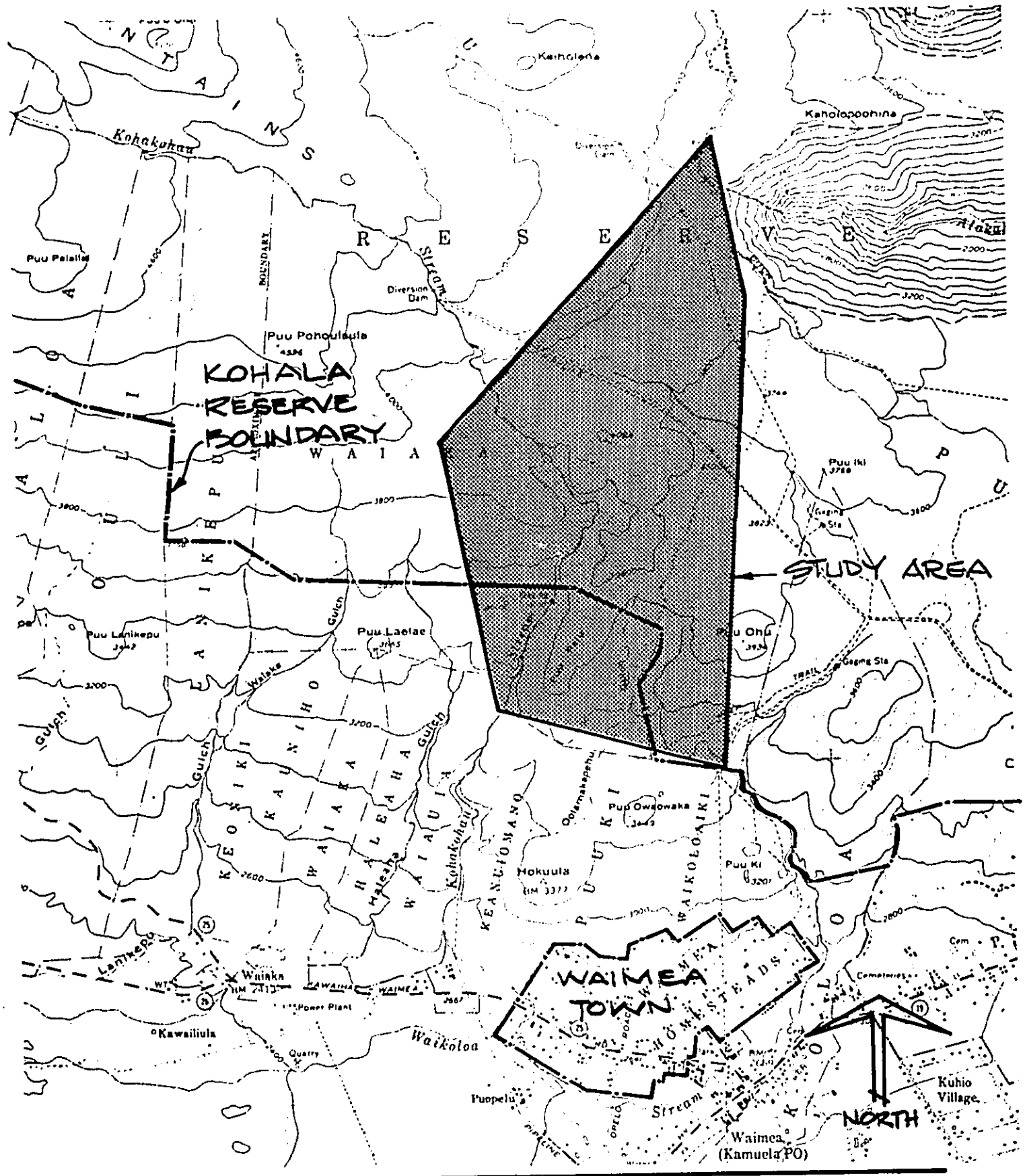


FIGURE : 4 KOHAKOHAU STUDY AREA

KOHAKOHAU EIS - SOUTH
KOHALA DISTRICT, HAWAII

by the Board of Land and Natural Resources, State of Hawaii, in order to promote intended objectives of the protective subzone.

The project study area (an estimated 1,000 acres) comprises approximately 2 per cent of the total area of the Kohala Forest Reserve, approximately 10 per cent of the total area of the Kohala Watershed Reserve, and an unknown per cent of the total area of the proposed protective subzone in which it would be located. Areas permanently affected by components of the project would represent a small portion of the total 1,000 - acre study area. These areas are identified in following discussions of the existing environment and the impacts of the Kohakohau Dam Project.

2 - Project Description

This environmental impact statement addresses the elements of the Kohakohau Dam Project as identified in previous studies and as further delineated and detailed in subsequent studies, investigations, and discussions. As currently proposed, the Kohakohau Dam Project comprises the elements discussed as follows.

A - Development Alternatives

Facilities considered in the Kohakohau Dam Project could be provided in two alternate schemes of development: (1) Ultimate development, resulting in an expected yield of 10 mgd, and (2) Staged development, resulting in an initial yield of 5 mgd which would be increased to 10 mgd at a future date by the expansion of facilities and structures. Each of these development alternatives is discussed as follows in terms of the major components required, the peripheral considerations, and the estimated construction costs.

B - Major Project Elements

Major facilities proposed in the Kohakohau Dam Project, as shown in Figure 5, and common to both the ultimate development and staged development alternatives, are (1) the primary dam structure, (2) the spillway chute, (3) the outlet pipe, and (4) the Upper Hamakua Ditch (UHD) diversion. Each development alternative incorporates unique features discussed as follows:

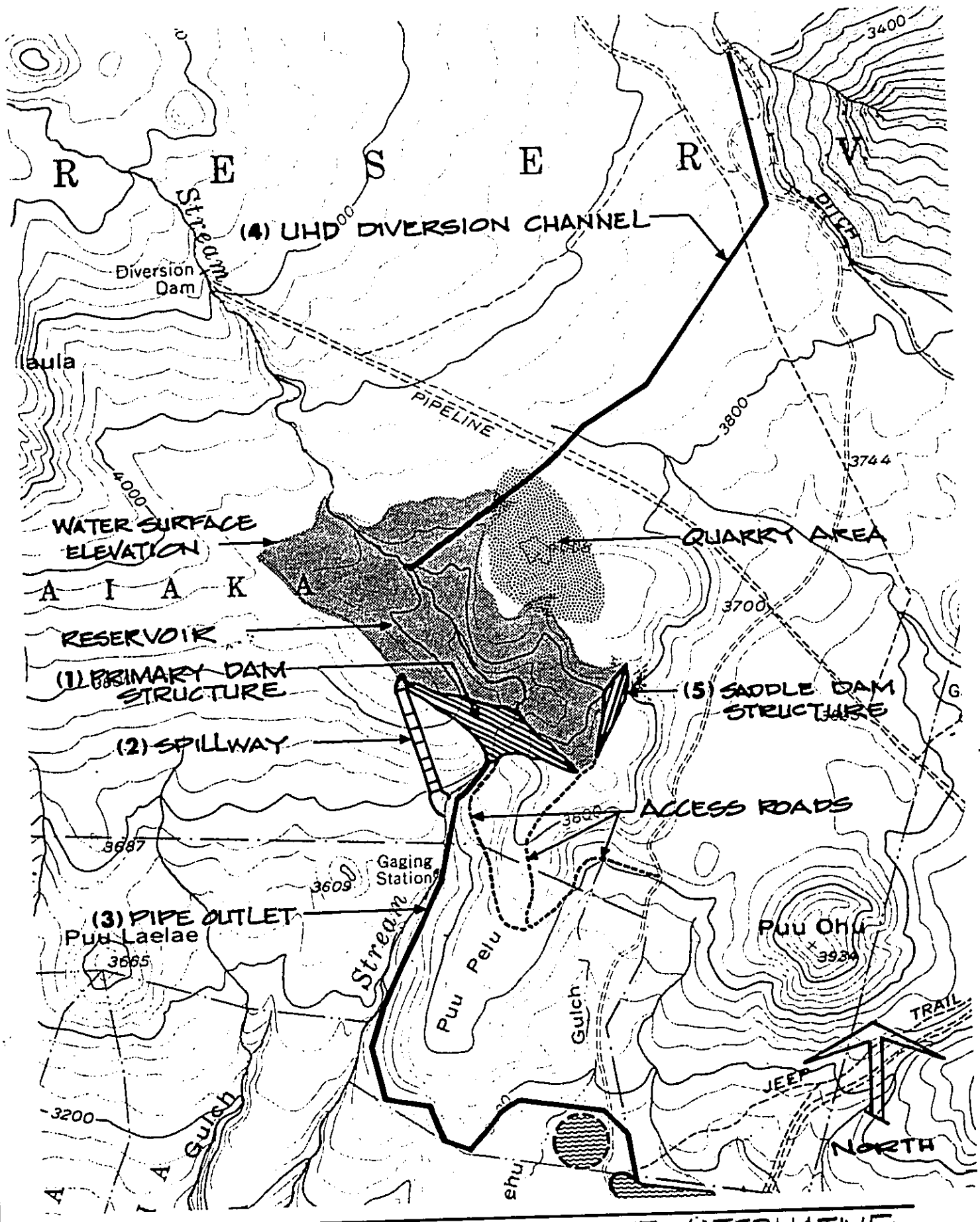


FIGURE: 5 ULTIMATE DEVELOPMENT ALTERNATIVE

KOHAKOHAU EIS-SOUTH
KOHALA DISTRICT, HAWAII

500 0 500 1500 FEET

1. Ultimate Development. Components of the ultimate development alternative, as shown in Figure 5, are:

a. Primary dam structure. The proposed dam would be constructed of rock fill with a reinforced concrete surface membrane and would rise 205 feet from the bottom stream elevation of 3,675 feet to elevation 3,880 feet.

b. Saddle dam structure. Also constructed of rock fill with a reinforced concrete membrane, the proposed saddle dam would rise 85 feet from the low point of the saddle.

c. Spillway. The preliminary spillway investigation specifies a 115-foot-wide structure about 1,100 feet in total length.

d. Outlet pipe. The proposed outlet pipe would extend some 4,030 feet from the reservoir to the existing Kohakohau Diversion pipeline, at approximate elevation 3,405 feet.

e. Upper Hamakua Ditch (UHD) Diversion Channel. The proposed 5-foot-wide channel would extend some 7,000 feet to the UHD at the Alakahi Stream.

The primary and saddle dams would impound waters of the Kohakohau and Alakai Streams to a working surface level of 3,869 feet in elevation. The proposed rock quarry area shown in Figure 5 was identified in the 1970 Feasibility Report 8/ as the best potential source of required construction material. Access trails and roads would be required approximately in the

8/ Reference 36.

areas indicated.

2. Staged Development. Components of the initial stage of development, as shown in Figure 6, are:

a. Primary dam structure. The proposed dam would be constructed of rock fill with a reinforced concrete surface membrane and would rise 145 feet from the stream bottom to an elevation of 3,820 feet.

b. Spillway. A structure of 115 feet in width and about 1,100 feet in length would be required.

c. Outlet pipe. The pipe required would extend from the reservoir to the existing Kohakohau Diversion pipeline.

d. UHD Diversion Channel. The required channel would extend the same 7,000 foot length to the Upper Hamakua Ditch at the Alakahi Stream.

The primary dam would impound water to a normal surface level of 3,807 feet in elevation. Required construction materials would be obtained from the same proposed quarry area, but in a smaller quantity. Access roads and trails would be required in essentially the same locations and scale as in the ultimate development alternative.

To reach the ultimate (10mgd) expected capacity of the site, the initial stage facilities could be expanded to the size of the ultimate development structures essentially by (1) extending the primary dam from elevation 3,820 to elevation 3,880 feet, (2) relocating the spillway structure, and(3) constructing the saddle dam.

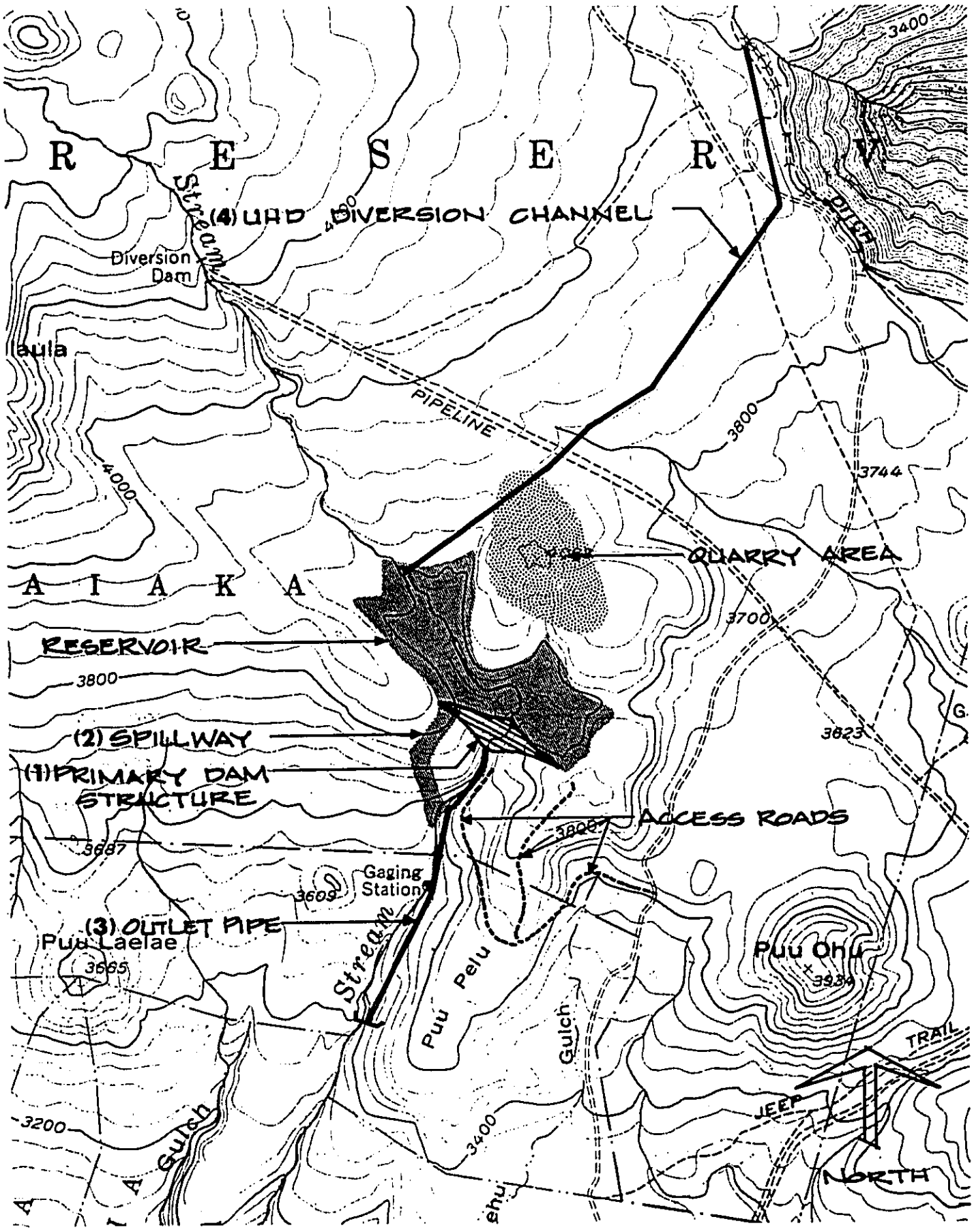


FIGURE: 6 INITIAL DEVELOPMENT ALTERNATIVE

KOHAKOHAU EIS - SOUTH
KOHALA DISTRICT, HAWAII

500 0 500 1500 FEET

C - Disturbed Areas and Other Considerations

Activities in the potential construction and operation of the Kohakohau Dam Project are expected to result in disturbance to the surface areas described as follows:

1. Area of Inundation. The area inundated in the initial stage of development would be approximately 80 acres; in the ultimate development alternative approximately 120 acres.

2. UHD Diversion Area. In either development alternative the area affected would be a strip approximately 7,000 feet in length from the reservoir to the existing junction of the Upper Hamakua Ditch and the Alakahi Stream. Maximum width of the channel would be 5 feet, and the section width required for construction would be about 20 feet.

3. Outlet Pipe Area. In either development alternative the area affected would be a strip approximately 4,000 feet in length from the primary dam to the existing Kohakohau Stream Diversion. The section required for construction would be about 20 feet.

4. Dam Fill Area. The area covered by fill material for the primary dam in the initial stage of development would be approximately 8 acres; in the ultimate development alternative approximately 10 acres for the primary dam and 5 acres for the saddle dam.

5. Spillway Area. In either development alternative the area affected would be approximately 115 feet in width by 1,100 feet in length, or about three acres.

6. Quarry Area. Each development alternative would require some quantity of rock materials from the area shown in Figures 5 and 6 which comprises approximately 40 acres upstream from the site of the primary dam. This area would be stripped and cleared to expose underlying rock materials.

7. Access Areas. Each development alternative would require major access routes in the locations shown in Figures 5 and 6 and minor access routes and trails throughout the project area.

In addition to these disruptions, construction of proposed facilities would entail (1) the temporary diversion of Kohakohau Streamwaters, and (2) the dewatering or filling of swampy areas where construction activities would be hampered.

1. Diversion of Streamwaters. As discussed in the 1970 Feasibility Report, 9/ diversion during construction could be achieved in the following ways:

a. Construction of a temporary cofferdam at a point about 1,000 feet upstream of the dam axis where the valley is narrow, perhaps near one of the waterfalls, and diversion of the water along the west abutment in a closed or open conduit. The elevation of the temporary diversion along the abutment and the conduit will depend upon the elevation and location of the temporary diversion dam. Once the construction of the pipe outlet through the dam is completed and the dam extends fully across the valley to a sufficient elevation, the pipe outlet can be used

9/ Ibid.

to divert the stream. Advantage can be taken of the storage volume provided by the dam to attenuate flows that exceed the pipe outlet capacity.

b. Construction of a tunnel through the west abutment which would serve as a diversion conduit during construction of the dam and as the spillway outlet after the dam is completed. The tunnel would be fitted with a vertical shaft morning glory spillway in the final condition.

2. Dewatering or Filling of Swampy Areas. Problems have been encountered in the past with the operation of equipment in the wet areas in the Forest Reserve. Existing access trails to the site and to other pipelines and ditches above the study area employ imported materials for stable and dry conditions. It is expected that activities in the wetter portions of the project area would encounter similar problems and require dewatering or filling.

D - Estimated Costs

Cost estimates were developed in the 1970 Feasibility Report 10/ for (1) Initial Stage, (2) Final Stage, and (3) Ultimate Development alternatives based on construction cost data guides, bids for previous water-related construction projects, and information obtained from local contractors. Table 1 presents a summary of those 1969 costs and estimated

10/ Ibid.

1974 equivalent costs. 11/ These revised figures represent expected construction costs if construction would occur in 1974. Clearly the uncertainty of inflationary trends and attendant increases in costs of materials, equipment, and labor could make these updated costs unrealistic. More importantly, the total lead time (e.g., the time required for planning, design, and construction) in implementing the Kohakohau Dam Project is estimated as 4 to 5 years, implying that these estimated 1974 costs could well increase another 30 percent (at current inflationary rates) before completion of the project.

Table 1

Updated Construction Cost Estimates

Development Alternative	Construction Year	
	1969	1974
(1) Initial Stage	$ 5.95 Million	$ 8.0 Million
(2) Final Stage	9.51 Million	12.5 Million
Total (Two-Stage)	15.46 Million	20.0 Million
(3) Ultimate (One-Stage)	14.26 Million	18.5 Million

11/ 1974 costs estimated as 30 percent higher than in 1969, based primarily on the First Hawaiian Bank construction cost index (Reference 15).

3 - Project Background and Purpose

A - Historical Narrative

In the early 1960's the domestic water supply facilities in South Kohala and Hamakua were unable to meet demand requirements during drought periods and exhibited substandard quality conditions of color and taste. With anticipation of additional domestic water demands from new coastal developments, concerns grew for the need for additional and reliable water supply facilities in the districts. In the period 1962 to 1964, the State of Hawaii, Department of Land and Natural Resources, Division of Water and Land Development, completed two preliminary reconnaissance studies, the Interim Report on Hamakua-Kohala Water Study, 12/ and the Preliminary Report on the Water Resources of Kohala Mountain and Mauna Kea. 13/ These studies indentified known sources of water and recommended further investigations of certain promising sources to evaluate future development potentials.

Then, in 1964, the Division of Water and Land Development undertook a comprehensive analysis of existing and potential domestic water supplies and facilities for South Kohala and Hamakua and, in the 1965 report, A Water Development Plan for South Kohala - Hamakua, 14/ presented a water development plan which would provide water for the demands of the foreseeable future by tapping surface waters on the southern slope of Kohala Mountain.

12/ Reference 34.
13/ Reference 39.
14/ Reference 31.

The elements of that plan included diversion, transmission, storage, and treatment facilities on the Waikoloa and Kohakohau Streams. Damming of the Kohakohau Stream was proposed "as a means of augmenting the water supply when future demands exceed 3.3 million gallons a day." 15/ Since that time the elements proposed in the recommended plan have been completed or are under construction (see Figure 8 and discussion of existing facilities) with the exception of the Kohakohau Dam Project.

In 1970 the State Division of Water and Land Development completed the Kohakohau Dam Engineering Feasibility 16/ study which investigated alternative dam sites and supported the engineering feasibility of a dam at an approximate elevation of 3,700 feet on the Kohakohau Stream. As previously discussed, that study outlines the project addressed in this environmental impact statement.

B - Existing Facilities

Existing domestic and agricultural water supply systems in the South Kohala and Hamakua Districts are summarized as follows and are shown on Figures 7, 8, and 9.

1. Domestic Systems. Three major domestic systems presently use water from South Kohala sources: (1) the Kawaihae-Puako System, (2) the Waimea-Puukapu System, and (3) the Hamakua System, as shown in Figure 7. South Kohala water supply facilities are shown in Figure 8. Those facilities include (1) the

15/ Ibid, page 6.
16/ Reference 36.

Waikoloa Diversion, (2) the lower 50 million gallon reservoir, (3) the Kohakohau Diversion, (4) the filtration plant, and (5) the upper 50-million gallon reservoir (under constuction).

Some private water supply and transmission facilities have been developed to meet local needs. Principal among these systems in the South Kohala and Hamakua Districts is the Boise-Cascade System, which employs privately-developed wells. The location of this system is shown in Figure 7.

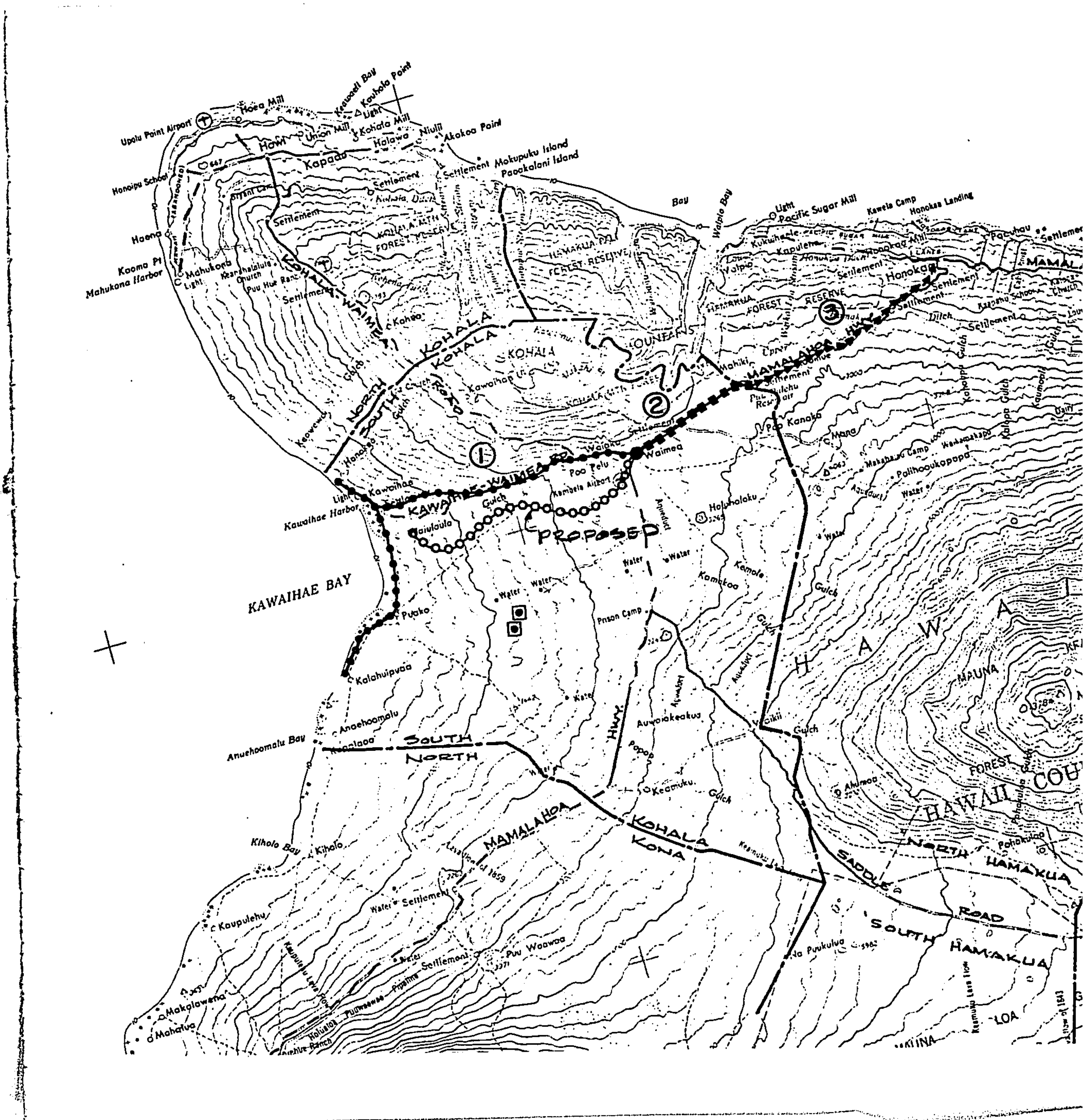
2. Agricultural Systems. Major agricultural systems in the South Kohala and Hamakua Districts are: (1) the Lalamilo Irrigation System, (2) the Parker Ranch System, and (3) the Hawaiian Irrigation Company System, shown in Figure 9.

C - Planned Facilities

As shown in Figure 7, the Hawaii County Department of Water Supply has proposed a 20-inch pipeline following the alignment of the proposed Waimea-Kawaihae Road. Other improvements include construction of a new water main from Waimea to Honokaa (presently under contract). The upper 50-million gallon reservoir (see Figure 8) is scheduled for completion in 1974.

D - The Role of the Kohakohau Dam Project

The Kohakohau Dam Project would supplement existing facilities in the South Kohala supply system (see Figure 8) by providing a total storage capacity and estimated yield of 390 million gallons and 5 mgd for the initial development alterna-



Upolu Point Airport
Hoea Mill
Keawaeli Bay
Kauhola Point
Light
Union Mill
Kohala Mill
Hawi
Halawa
Niulii
Akokoa Point
Kapaau
Mokupuku Island
Paoakalani Island
Honoipu School
Settlement
Haena
Kooma Pt
Mahukona Harbor
Mahukona
Light
Church
Puu Hue Ranch
Kahua
KOHALA-WAIMEA
KOHALA MTN
FOREST RESERVE
HAMAKUA PALI
FOREST RESERVE
Bay
Waipio Bay
Light
Pacific Sugar Mill
Kawela Camp
Honokaa Landing
Kukuihaele
Kapulena
Waipio
Honokaa Mill
Honokaa
Paauhau
Settlement
MAMALAHOA HWY
Ditch
NORTH
SOUTH
KOHALA
Kawaihae
Kawaihae Harbor
Light
KAWAIHAE-WAIMEA RD
Gulch
Waiaka
Waimea
Poo Pelu
Kamuela Airport
Poo Kanaka
Puu Reservoir
Holoholoku
PROPOSED
Makahalau Camp
Waikoloa
Water
Kamakoa
Kamole
Gulch
KAWAIHAE BAY
Puako
Prison Camp
Kalahuipuaa
Anaehoomalu
Anaehoomalu Bay
Keaniaa
SOUTH
NORTH
HWY.
Auwaiakeakua
Popoo
Keamuku
Gulch
Waikii
Gulch
Ahumoa
MAUNA
FOREST
HAWAII
KOHALA
KONA
MAMALAHOA
Lava flow of 1859
Kiholo Bay
Kiholo
Settlement
Kaupulehu
Kaupulehu Lava Flow
SADDLE
NORTH
HAMAKUA
ROAD
SOUTH
HAMAKUA
Na Puukulua
Puu Waawaa
Puuwaawaa Pipeline
Settlement
Huehue Ranch
Makalawena
Mahaiula
LOA

① KAWAIHAE - PUAKO SYSTEM
② WAIMEA - PUUKAPU SYSTEM
③ HAMAKUA SYSTEM
▣ BOISE CASCADE WELLS

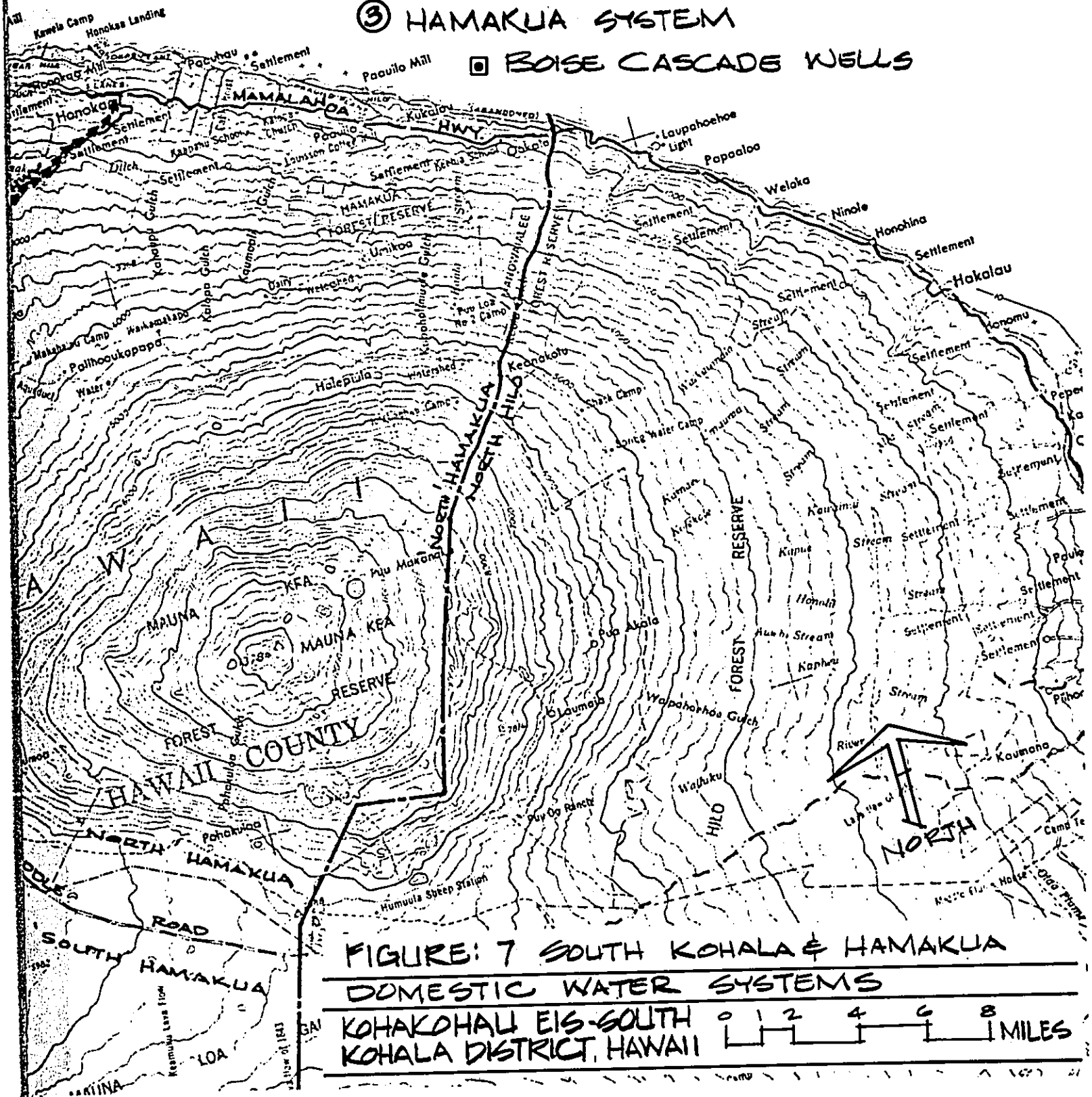


FIGURE: 7 SOUTH KOHALA & HAMAKUA
DOMESTIC WATER SYSTEMS
KOHAKOHAU EIS-SOUTH
KOHALA DISTRICT, HAWAII

0 1 2 4 6 8 MILES

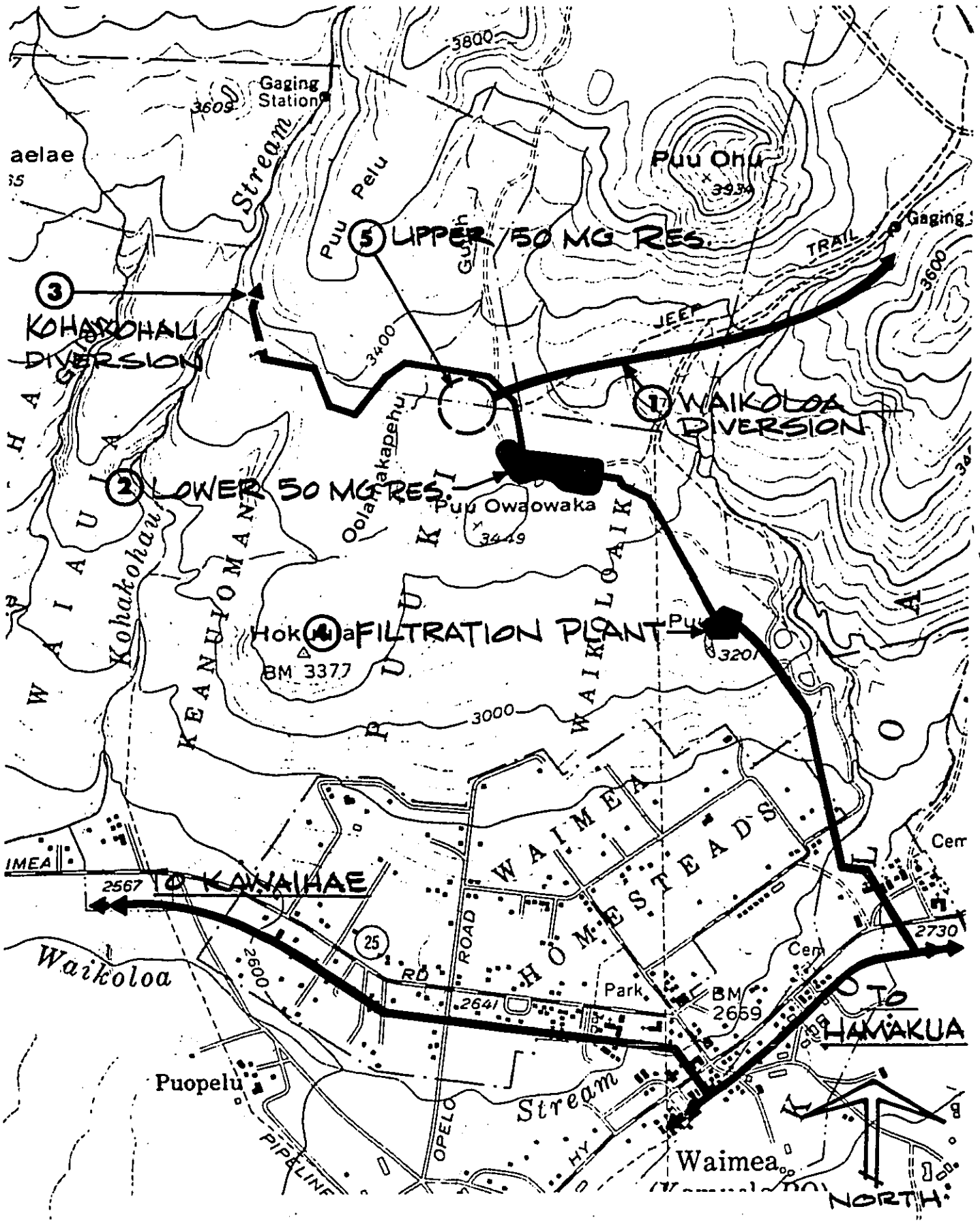


FIGURE: 8 SOUTH KOHALA WATER SUPPLY FACILITIES

KOHAKOHAU EIS-SOUTH KOHALA DISTRICT, HAWAII

tive or 1,787 million gallons and 10 mgd for the ultimate development alternative. Impounded waters would be used primarily to meet existing and future domestic demands.

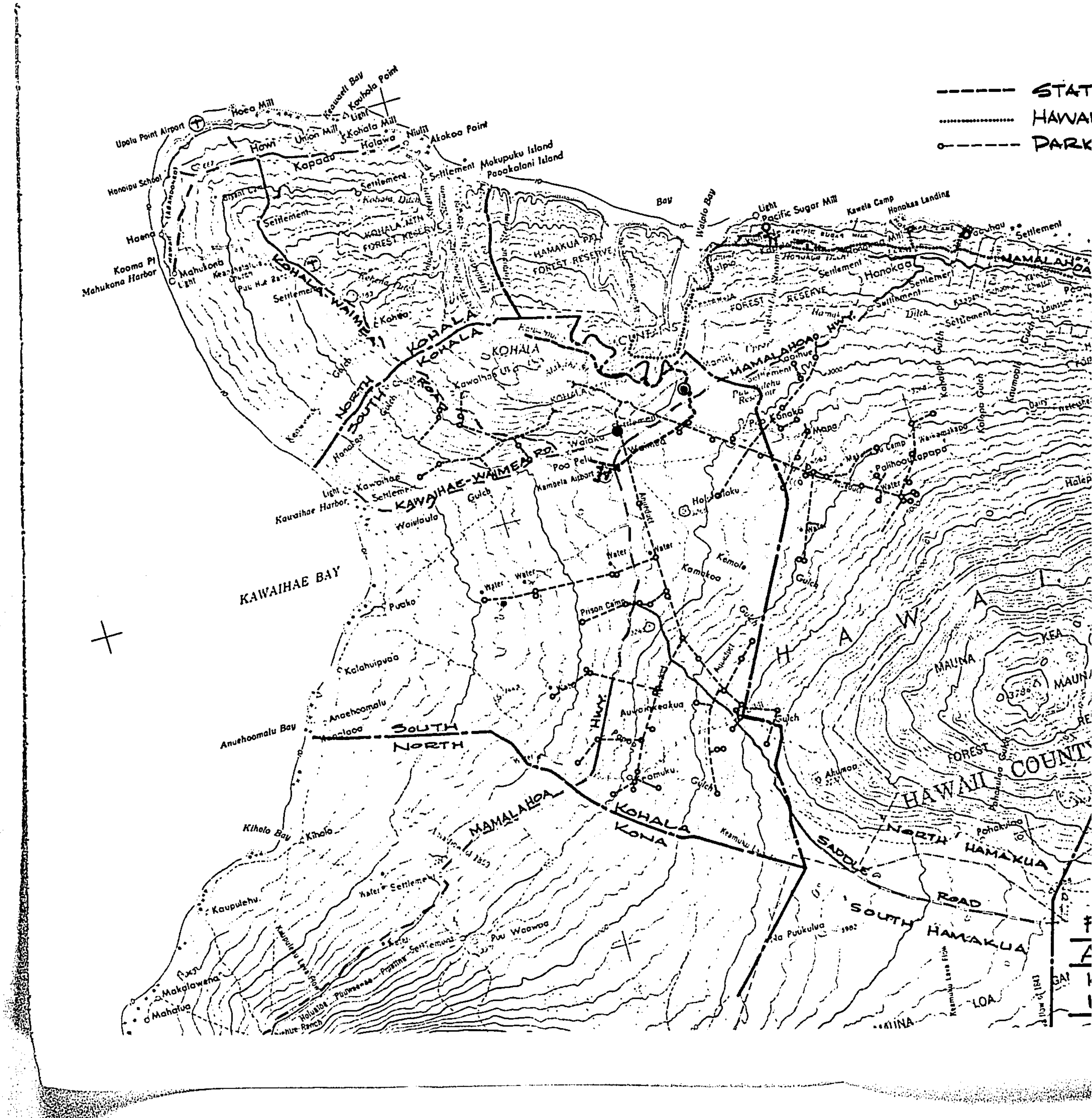
It is intended that surface waters impounded by the dam would be treated and used in Waimea and Hamakua, and mixed with brackish well water in the coastal areas (see Figure 22 and accompanying discussion of brackish well development). By mixing these fresh waters with brackish well water on a variable mix basis (depending upon salinity of the well water), the total domestic yield provided in coastal areas would be a multiple of the quantity of impounded water used.

E - Legal Considerations

The State of Hawaii, Division of Water and Land Development has conducted investigations of the water rights and other legal considerations in relation to the South Kohala-Hamakua Water Study and Kohakohau Stream studies. 17/ Studies and negotiations have culminated in written agreements and court decisions with Kohakohau Stream, Waikoloa Stream, and Upper Hamakua Ditch (UHD) water right holders concerning the proposed Kohakohau Dam Project.

In brief, the agreements represent the conclusion of negotiations to the satisfaction of all parties concerned and permit major future draws above the potential damsite by private water right holders and very small claims to waters below the potential damsite. No legal minimum flow requirement exists below the proposed damsite other than that flow required to

17/ See References 38 and 78.



STAT
HAWAI
PARK
Upolu Point Airport
Hoea Mill
Union Mill
Kohala Mill
Kohala Point
Niulii
Akokoa Point
Hawi
Kapaau
Halawa
Mokupuku Island
Paoakalani Island
Honoipu School
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Mahukona Harbor
Settlement
KOHALA MTN
FOREST RESERVE
HAMAKUA PT
FOREST RESERVE
Bay
Waipio Bay
Light
Pacific Sugar Mill
Kawela Camp
Honokaa Landing
Honokaa
Settlement
FOREST RESERVE
HAMALAHOA HWY
KOHALA
NORTH
SOUTH
KOHALA
KOHALA
ROAD
Waiaka
Waimea
Poo Pelu
Kamuela Airport
KAWAIHAE-WAIMEA RD.
Light
Kawaihae
Kawaihae Harbor
Waiaulaula
Gulch
KAWAIHAE BAY
Puako
Water
Prison Camp
Holoholoku
Kemole
Kamakoa
Gulch
Kalahuipuaa
Anaehoomalu
Anaehoomalu Bay
SOUTH
NORTH
HWY.
MAMALAHOA
KOHALA
KONA
Keamuku
Kiholo Bay
Kiholo
Kaupulehu
Makalawena
Mahaiula
Puu Waawaa
SADDLE
ROAD
NORTH
HAMAKUA
SOUTH
HAMAKUA
Puu Anahulu
HAWAII
HAWAII COUNTY
MAUNA
KEA
FOREST
Ahumoa
Pohakuloa
Mana
Kapapa
Kaala
Kalopa Gulch
Kukaiau
LOA

------ STATE SYSTEM (Irrigation)

..... HAWAIIAN IRRIGATION CO. SYSTEM (Irrtn & Domestic)

o------ PARKER RANCH SYSTEM (STOCK)

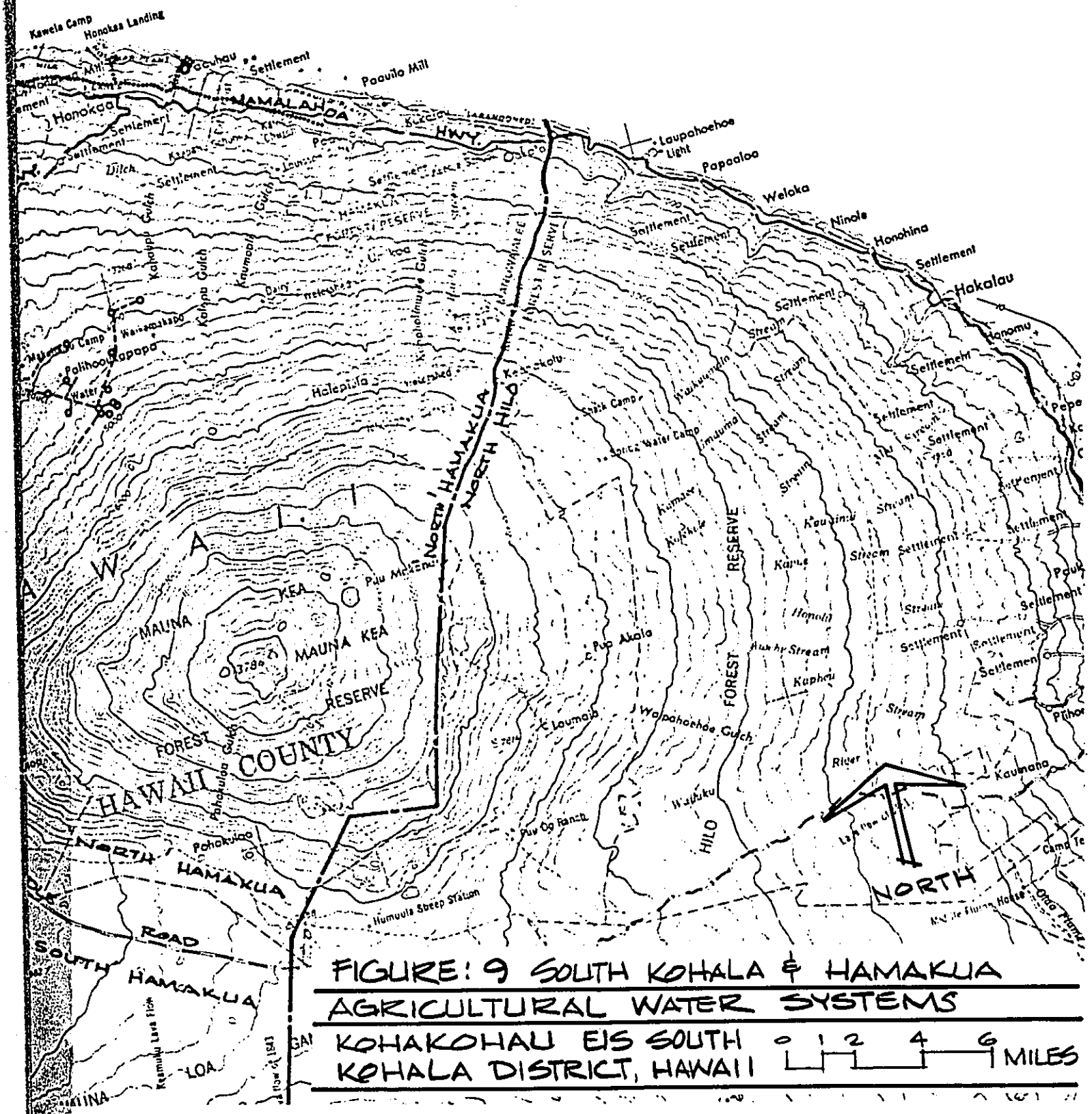


FIGURE: 9 SOUTH KOHALA & HAMAKUA AGRICULTURAL WATER SYSTEMS

KOHAKOHAU EIS SOUTH KOHALA DISTRICT, HAWAII

0 1 2 4 6 MILES

supply that minor private claim.

4 - Current Status of the Project

The 1970 Feasibility Report 18/ on the Kohakohau Dam Project represents the completion of preliminary planning and engineering studies for the project. No additional studies have been completed or initiated since that time, no construction bids have been solicited or contracts negotiated, and no State construction funds are presently appropriated for the project. It is intended that after this environmental impact statement is completed and analyzed, a decision will be made on whether or not to proceed with the project as presently proposed or in a modified form.

Should the decision be made to proceed with the project as outlined in the 1970 Feasibility Report, 19/ it is certain that additional engineering studies would be required before construction would begin. Precise future dates for construction and completion could not be predicted at this time; however, it is estimated that actual construction of the dam and supporting structures would require a minimum of two or three years with a construction force in the order of fifty workers. Total lead time (e.g., the time required for planning, site explorations, design, advertising and negotiating of contracts, and actual construction) for the project is estimated to be four or five years; therefore, should the decision be made in early 1975 to proceed with the project, completion of proposed facilities could not be expected before 1979 or 1980.

18/ Reference 36.
19/ Ibid.

II. EXISTING ENVIRONMENT

SOCIO-ECONOMIC SETTING

1 - History and Archaelogic Potential

The North and South Kohala Districts of the island of Hawaii exhibit a rich history and display numerous existing sites and places of historic and archaeologic interest. As the birthplace of King Kamehameha I, the Kohala area is significant in Hawaiian history.

A - History

In about 450 A.D. the Hawaiian Islands were occupied by people of the Polynesian race. A large number of immigrants, believed to be from Tahiti, arrived about 1100 A.D. The great Hawaiian warrior and ruler King Kamehameha I was born in Kohala in 1736. The first recorded contact by Europeans with the Hawaiian Islands was in 1778 when Captain James Cook visited, and the island of Hawaii first received European visitors in 1779 when Captain Cook dropped anchor in Kealakekua Bay, south of where Kailua is located today, on the western shore of the island. In 1793 British Captain George Vancouver commented on the "villages and plantations of the fertile, populous western part of Kohala and the rich productive plains of Waimea." 20/ Having cattle on board as a gift for King Kamehameha I, Vancouver especially noted the "luxuriant natural pasture" in Waimea. In 1820, missionaries on the sailing ship Thaddeus described the

20/ Historical quotations taken from Reference 44.

"green slopes of Kohala." Other explorers before 1800 described the area from Mahukona (in the North Kohala District) to Puako (south of Kawaihae) as "extensively cultivated and productive."

During the late eighteenth and early nineteenth centuries, commerce and other activities in the Kohala areas effected changes in the natural landscape. In 1832 the Rev. Lorenzo Lyons, a Congregational missionary living in Waimea, wrote, "Kawaihae is about as desolate a place as I have ever seen, nothing but barrenness with here and there a native hut." The forest which had extended to a much lower elevation than today had been destroyed by trade in sandalwood (iliahi), cutting of the remaining trees for firewood, and the large wild herds of cattle and goats descendant from Vancouver's original herd. In 1815 John Palmer Parker was hired to thin these wild herds and remained to establish the Parker Ranch which still operates today as one of the largest ranches in the world.

B - Archaeologic Potential

There is considerable visible evidence remaing today that large Hawaiian settlements were located in the Kohala areas prior to 1800. The ruins of numerous large stone temples (heiaus), walls of former Hawaiian villages, and remnants of ancient agricultural systems are visible in the lower coastal areas of the North Kohala, South Kohala, and Kona Districts. Large temple platforms and enclosures built of local rock are preserved at Kawaihae, and the Puukohala Hɔaiu, at Kawaihae, is listed as a State historic site and a National Historic Landmark. In addition, petroglyphs have been found near the

Lalamilo agricultural area, 21/ approximately ten miles south and west of the proposed damsite, as shown on Figure 10.

Although numerous visible historic sites exist along coastal lands and lowlands in West Hawaii, and an extensive system of ancient rock walls, believed to have marked agricultural plots, on the northwestern slope of Kohala Mountain is discernable from the air, there is no evidence that similar or other sites exist in the study area (see Figure 4). The area is believed to be too high in elevation to have been devoted toancient agriculture and could only have been visited in transitory uses.

The Federal Register and the State list of Historic Sites include no sites within the study area. The State of Hawaii, Department of Land and Natural Resources, Division of State Parks has analyzed available records and stereo air photographs and has found no historic or archaeological sites in the area. Field surveys of the study area conducted for general reconnaissance and studies of flora and fauna during January, February, and March, 1974, resulted in no sightings of suspected historic or archaeologic sites.

In addition, contacts with other agencies and historians including the Bishop Museum, the Kamuela Museum, the University of Hawaii Department of Anthropology (Manoa), the University of Hawaii Department of Social Sciences (Hilo), and the County of Hawaii Planning Department have resulted in the identification of no known historic or archaeologic sites in the study area.

21/ From Reference 6.

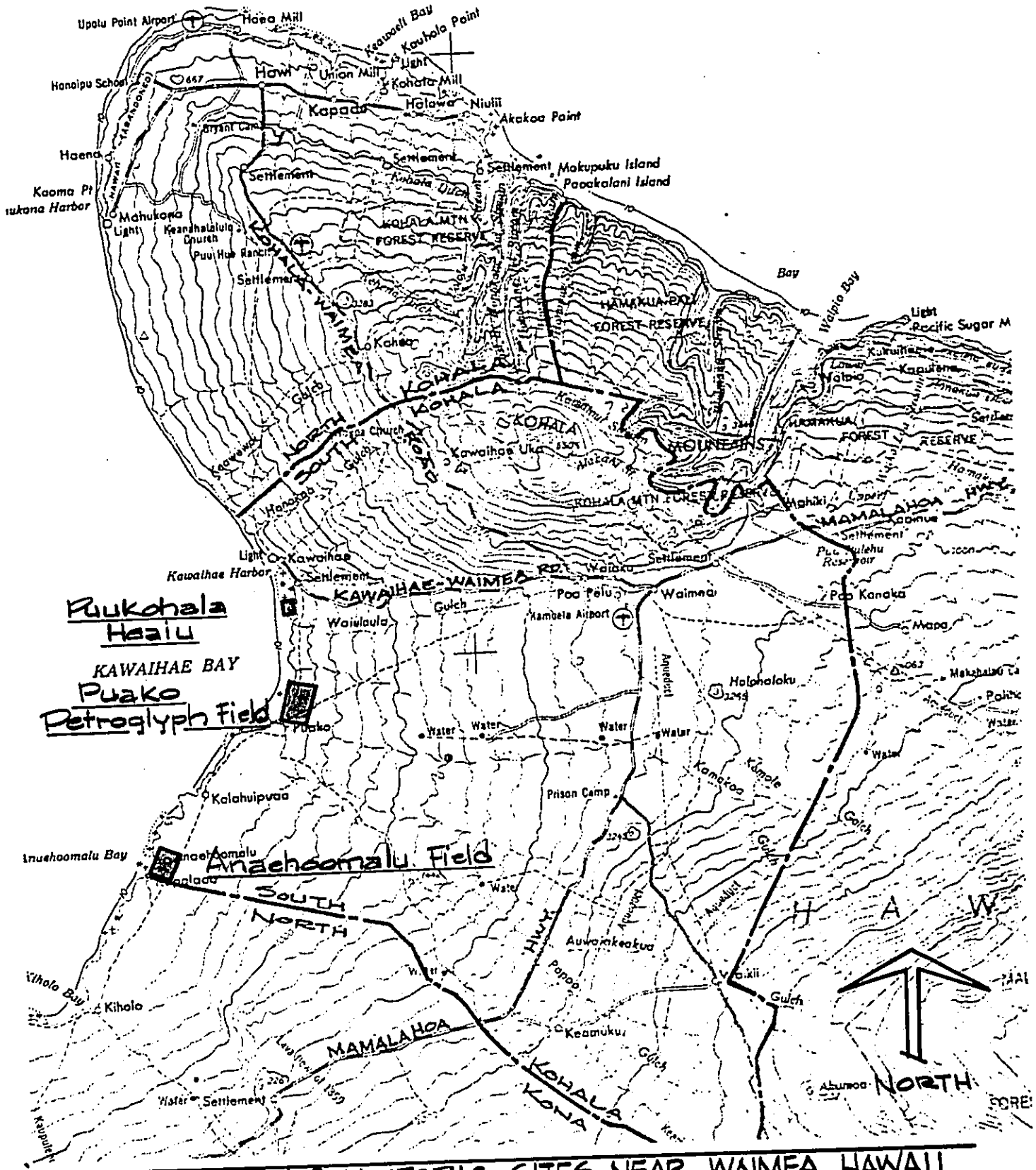


FIGURE: 10 HISTORIC SITES NEAR WAIMEA, HAWAII

KOHAKOHAU EIS - SOUTH
KOHALA DISTRICT, HAWAII

0 1 2 4 6 8 MILES

2 - General Development Patterns

The Hamakua District, historically dependent economically on the sugar cane industry, has exhibited a decline in population and development since before 1950. This decline has been largely caused by the mechanization of sugar plantations. Within the district, sugar, cattle, macadamia nuts, and diversified agriculture provide income and employment. There has been some migration into the town of Honokaa, the commercial and residential center of the district, but the district population has continued to decline. Tourism has historically played no significant role in the Hamakua District.

The South Kohala District, on the other hand, has exhibited a significant growth trend since 1950,and, in the decade 1960 to 1970, displayed the greatest percentage increase in population of any district in Hawaii County. Within the district, cattle ranching, diversified agriculture, and tourism are primary bases of income and employment. There is presently a considerable amount of investor interest in South Kohala, and several large resort and residential development projects are planned south of Waimea and along the coast. Kawaihae Harbor is the second deepwater port on the island and provides the opportunity for new recreational, commerical, and industrial activities, although no substantial activity or development has been realized to date.

The opening of the Mauna Kea Beach Hotel in 1965 and the development of irrigated tracts for truck framing in the Lalamilo area in 1961 have spurred activity in the South Kohala District in the 1960's.

3 - Population and Land Use

A - Population

Historical resident population in the South Kohala and Hamakua Districts is given in Table 2. 22/ As indicated, 1970 marked the first census year that the trend of declining population in the combined districts was reversed, resulting from the significant growth in the South Kohala District from 1960 to 1970 (an increase of 772 persons, representing a 50.2% change in ten years).

B - Land Use

The South Kohala and Hamakua Districts comprise a combined total of over 570,000 acres of land area (about 890 square miles, or 22 percent of the total area of the island of Hawaii). Of that combined total, about 174,000 acres are included in the South Kohala District (about 30 percent) and about 396,000 acres comprise the Hamakua District (the remaining 70 percent).

The State of Hawaii Land Use Commission has classified all lands of the State by four designations: (1) Urban, (2) Rural, (3) Agricultural, and (4) Conservation. These designations provide the legal framework for implementing planning objectives and regulating land uses. The Comprehensive Zoning Ordinance for the County of Hawaii 23/ is the legal instrument which regulates the use of land in the judicial districts and establishes nine zoning categories: (1) Single-family resi-

22/ Data for Table 2 are taken from Reference 8.
23/ Reference 5.

Table 2

Resident Population, South Kohala and Hamakua Districts 1970 - 1971.

	Jan.1 1920	Apr.1 1930	Apr.1 1940	Apr.1 1950	Apr.1 1960	Apr.1 1970	Jul.1 1971
South Kohala District	1,304	1,250	1,1352	1,505	1,538	2,310	2,394
Waimea					657	756	
Other					881	1,554	
Hamakua District	9,122	8,864	8,244	6,056	5,221	4,648	4,795
Honokaa					1,247	1,555	
Kukuihaele					424	310	
Paauilo					1,059	710	
Other					2,491	2,073	
TOTAL	10,426	10,114	9,595	7,561	6,759	6,958	7,189

dential, (2) Multiple residential, (3) Resort, (4) Commercial, (5) Industrial, (6) Residential-Agriculture, (7) Agriculture, (8) Open, and (9) Unplanned.

Within the South Kohala and Hamakua Districts, the Waimea, Kawaihae, and Honokaa-Paauilo areas exhibit the greatest relative current development as evidence by the numbers of acres of lands devoted to urban and high-density uses. Large areas in each of the districts are either zoned for urban and high-density uses and are vacant or are zoned as "Unplanned" and are presumably available for future development.

Areas for projections

4 - Economy and Employment

A - Economic and Manpower Indicators

Tables 3 and 4 present selected economic indicators for the South Kohala and Hamakua Districts based on 1970 Census data. 24/ As indicated, "other industries", primarily agriculture, employ a high proportion of the workers in each district. In the South Kohala District, truck farming and ranching employed nearly one-quarter of all workers; in the Hamakua District, sugar production employed a high percentage of workers. Other important industries in the Hamakua District are manufacturing and personal services.

Median 1969 family income was $9,181 in the South Kohala District and $8,373 in the Hamakua District, compared with the Hawaii County median of $9,750 and the State median of $11,553. Lower income levels in these districts are attributed to the partial domination of agricultural activities. Unemployment was 4.1 per cent in South Kohala and 1.5 per cent in Hamakua, compared with the Hawaii County rate of 2.8 per cent and the State rate of 3.0 per cent.

24/ Reference 68.

Table 3

1969 Economic and Manpower Indicators, Profile A

ITEM	SOUTH KOHALA DISTRICT		HAMAKUA DISTRICT	
	Number	Percent Distribution	Number	Percent Distribution
Population				
Total	2,310	100.0	4,648	100.0
White	906	39.2	1,611	34.7
Non-White	1,404	60.8	3,037	65.3
Labor Force Status				
Civilian Labor Force	951	100.0	1,816	100.0
Employed	912	95.9	1,788	98.5
Unemployed	39	4.1	28	1.5
Class of Worker				
Total Workers	912	100.0	1,788	100.0
Wage & Salaried	740	81.1	1,348	75.4
Government	90	9.1	296	16.5
Self-employed	66	7.2	139	7.8
Unpaid Family Worker	16	1.8	5	0.3
Industry				
Total Workers	912	100.0	1,788	100.0
Construction	124	13.5	156	8.7
Manufacturing	21	2.3	501	28.0
Transportation	28	3.1	16	1.0
Comm. & Utilities	9	1.0	30	1.7
Wholesale Trade	8	0.9	0	0
Retail Trade	145	15.9	145	8.1
Fiance, Ins. & Real Estate	32	3.5	11	0.6
Business & Repair Services	14	1.5	5	0.3
Personal Services	163	17.9	192	10.7
Health Services	18	2.0	47	2.6
Educational Services	92	10.0	109	6.1
Other Professional Services	17	1.9	37	2.1
Public Administration	28	3.1	118	6.6
Other Industries	213	23.4	421	23.5

Table 4

1969 Economic and Manpower Indicators, Profile B

ITEM	SOUTH KOHALA DISTRICT		HAMAKUA DISTRICT	
	Number	Percent Distribution	Number	Percent Distribution
Occupation				
Total Workers	912	100.0	1,788	100.0
Professional & Technical	99	10.8	128	7.1
Managerial & Administrative	94	10.3	68	3.8
Sales Workers	63	6.9	47	2.6
Clerical Workers	90	9.9	126	7.0
Craftmen & Foremen	150	16.4	319	17.8
Operatives	73	8.0	281	15.7
Laborers, exc. farm	47	5.2	132	7.4
Farm Workers	151	16.6	376	21.0
Service Workers	126	13.8	290	16.2
Private Household Workers	19	2.1	21	1.2
Income - 1969				
Total families	562	100.0	1,086	100.0
Median Family Income	$9,181	---	$8,373	---
Families Below Poverty Level	63	11.2	129	11.9
Families with Public Assistance Income	23	4.1	63	5.8
Vietnam-era Vaterans				
Years of School Completed				
Persons, 25 years & over	1,233	100.0	2,615	100.0
No School years completed	32	2.6	290	11.0
Elementary: 1-8 years	265	21.5	995	38.0
High School: 1-3 years	255	18.2	444	17.0
4 years	422	34.2	653	25.0
College: 1-3 years	128	10.4	93	3.6
4 years & more	161	13.1	140	5.4
Median School Years Completed	12.2	---	9.2	---
High School Graduates	711	57.7	886	33.9

B - Agriculture, Commerce, and Industry

Although sugar production has been the primary agricultural activity in the Hamakua District, other agricultural interests currently include ranching, dairying, hog raising, macadamia nut production, and truck farming. The decline of sugar production in the district has released some lands for private cultivation, and the 1971 General Plan 25/ recommends development of diversified agriculture in the area. The Kamuela area in the South Kohala District exhibits some of the most productive truck farming land in the county. The opening of the Lalamilo farmlots southwest of Waimea in 1961 provided new opportunities for private agricultural development. Various sources, notably the 1971 General Plan 26/ and the Big Island Agriculture Development Seminar, 27/ have outlined the need for County and State assistance in providing additional water at reasonable costs for agricultural needs in the South Kohala District.

The towns of Honokaa and Waimea provide primary commercial facilities for the Hamakua and South Kohala Districts, respectively. The establishment of these towns as regional commercial centers has been encouraged. In addition, the Kawaihae area and existing and proposed developments along the coast south of Kawaihae are expected to contain other commercial facilities.

Sugar processing is the major industrial activity in Hamakua. Macadamia nut processing and other industrial activ-

25/ Reference 6.
26/ Ibid.
27/ Reference 58.

ities of a smaller scale have been encouraged. Waimea and Kawaihae are the primary locations of industrial activity in South Kohala. Industrial activities at Waimea include food processing and dairying, and at Kawaihae include storage and chemical production. The Kawaihae Harbor area is proposed as a major port facility.

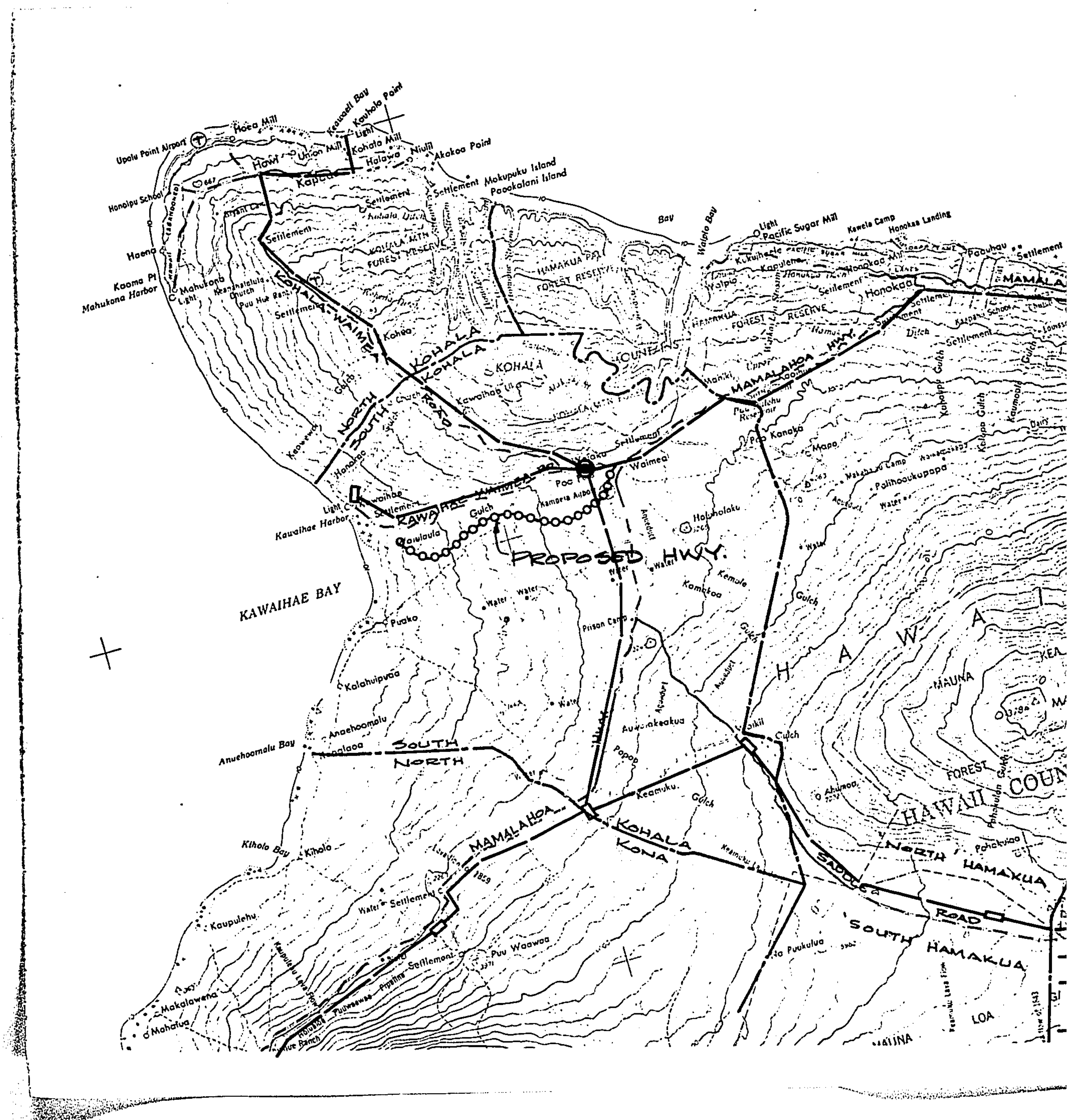
5 - Power and Transportation

A - Power

Electricity is the major form of energy utilized on the island of Hawaii. The Hilo Electric Light Company operates five power generation plants in the County. Three are located in Hilo, one in Waimea, and one in Ka'u. The total generating capacity of the Waimea plant is 11,250 kilowatts. Substations are found in Kawaihae and other locations. The primary source of energy for the power generating plants is imported fuel oil, which has resulted in power rates on the island comparing with the highest in the nation. One of the Hilo plants generates power from hydroelectric sources. Locations of the Waimea plant and the Kawaihae substation are shown in Figure 11.

In the period 1960 to 1969, power consumption in Hawaii County increased 125 per cent, and average annual consumption per household increased from 3,084 kilowatt hours to 4,845 kilowatt hours, while population during the same period rose only 3.5 per cent. 28/ Assuming an average annual consumption of 5,870 kilowatt hours per household, 29/ it is estimated that the town of Waimea (estimated 250 households in 1973) uses an average of 70 kilowatts (steady demand) or 4020 kilowatt hours per day. The 1971 cost of power in Hawaii County was 3 to 4¢ per kilowatt hour, 30/ compared with an estimated median rate of 1.5 to 2.0¢

28/ From Reference 6.
29/ Average 1971 use on the outer islands, from Reference 19.
30/ Reference 19.



PROPOSED HWY.
KAWAIHAE BAY
Upolu Point Airport
Hawi
Kapaau
Kohala Mill
Union Mill
Akakoa Point
Mokupuku Island
Paaokalani Island
Honoipu School
Haena
Kaoma Pt
Mahukona Harbor
KOHALA-WAIMEA
KOHALA
NORTH
SOUTH
KOHALA MTN FOREST RESERVE
HAMAKUA FOREST RESERVE
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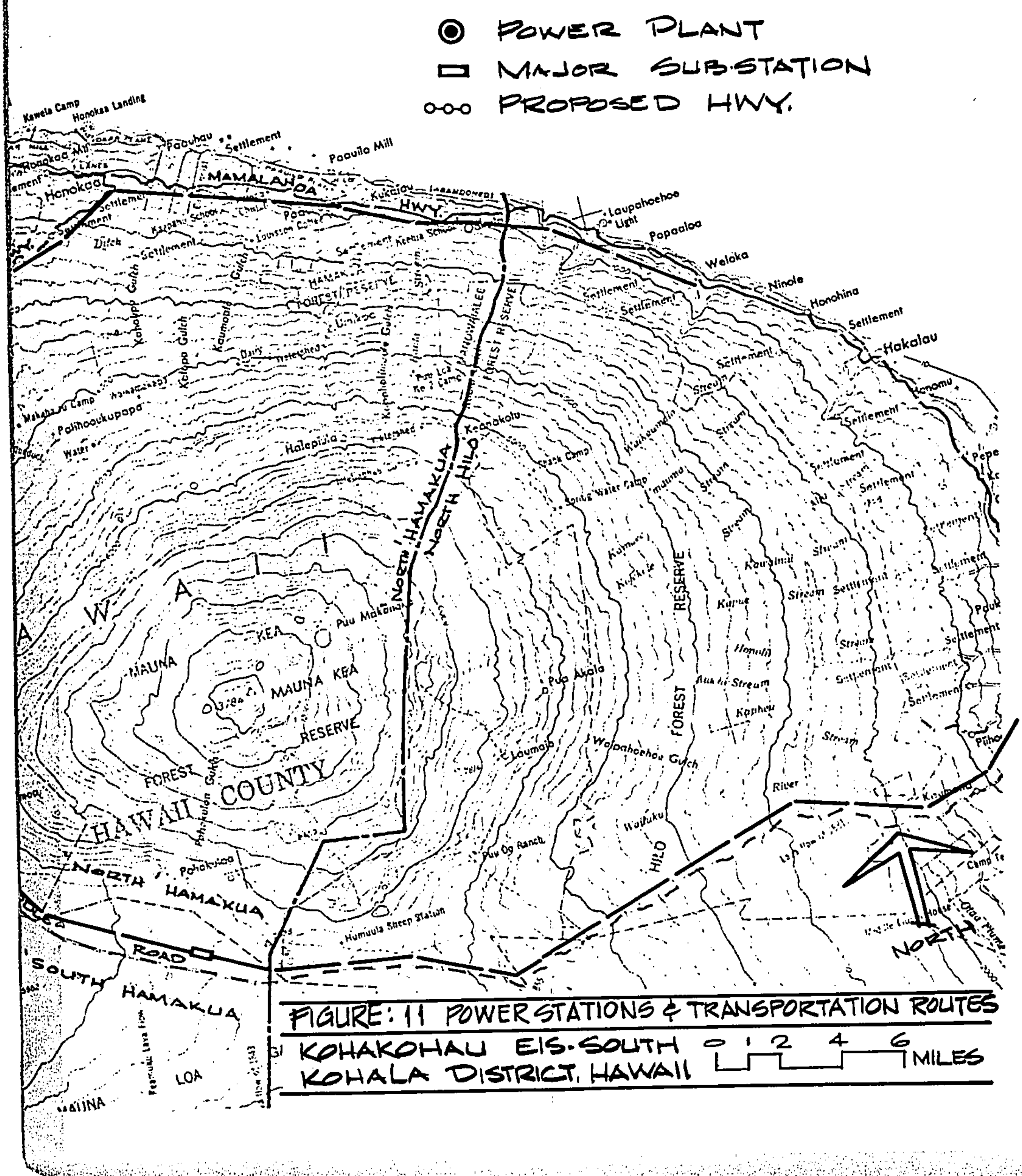


FIGURE: 11 POWER STATIONS & TRANSPORTATION ROUTES

KOHAKOHAU EIS - SOUTH KOHALA DISTRICT, HAWAII

per kilowatt hour on the mainland. In addition, rising costs for fuel oil are expected to increase the already high 1973 power rates.

B - Transportation

As shown in Figure 11, the South Kohala and Hamakua Districts are served by the Hawaii Belt Highway from Hilo, the Saddle Road from Hilo, the Mamalahoa Highway from Kona, and the Waimea-Kawaihae Road. A new route to replace the Waimea-Kawaihae Road has been proposed, as shown on Figure 11, and has received some disapproval from local residents. This new route would have a significant impact on the pattern of development and land use in the South Kohala District. The proposal is currently under evaluation by the State Department of Transportation and an environmental impact statement is in preparation at this time. Most recent information indicates that construction of the highway would not begin before the period of 1976 to 1978. The route from Kawaihae to Kona is under construction at this time.

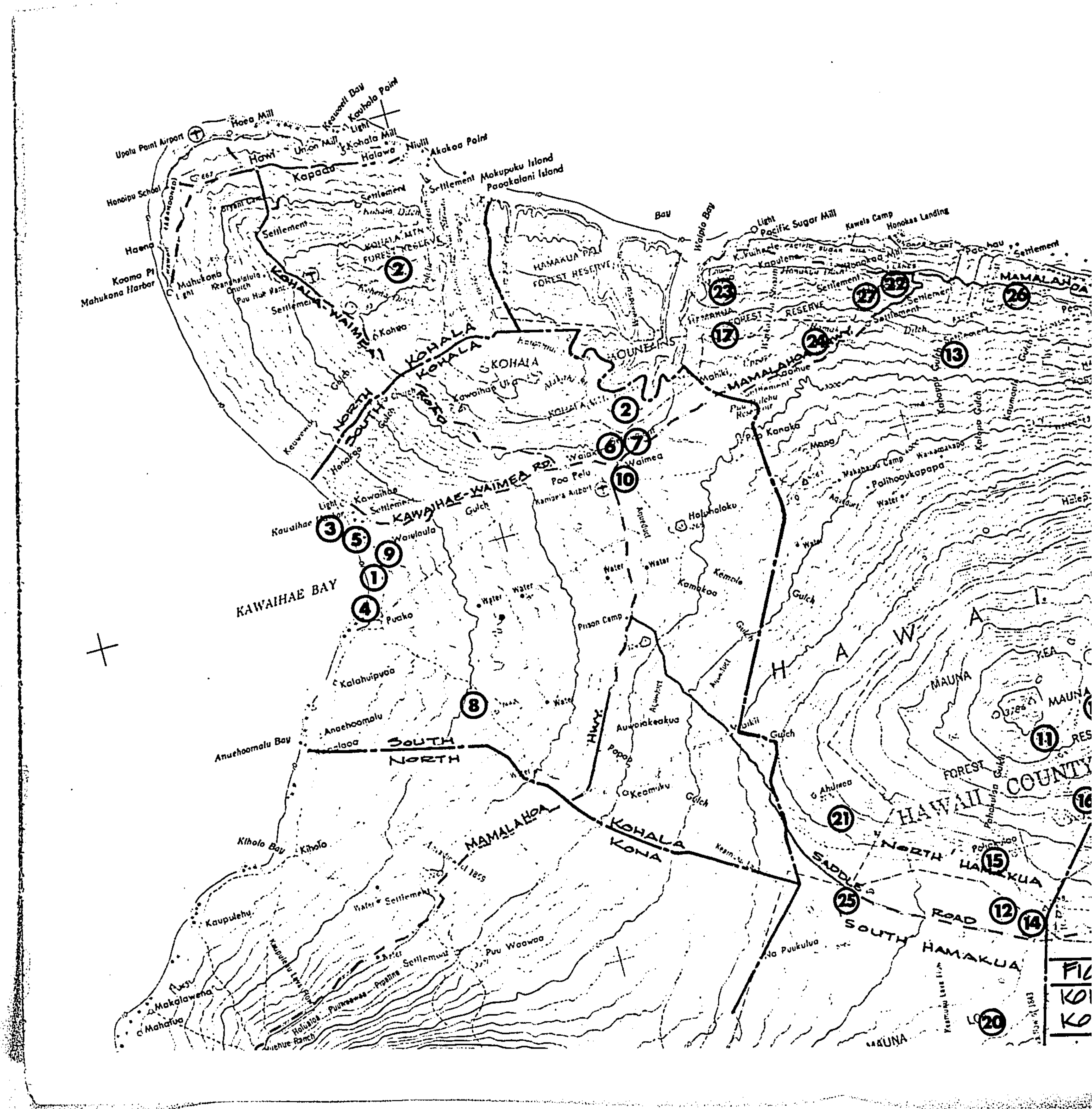
An air terminal is located at Kamuela in the South Kohala District. Other airports are located outside the South Kohala and Hamakua Districts at distances of approximately 20 to 60 miles. A major deepwater port facility is proposed at Kawaihae, but existing commercial traffic in the harbor is light.

6 - Recreation

Existing outdoor recreational sites in the South Kohala and Hamakua Districts emphasize camping and hiking at inland facilities and swimming, surfing, boating, and camping at waterfront facilities. Table 5 summarizes existing major sites in the South Kohala and Hamakua Districts as recorded in the 1971 State Comprehensive Outdoor Recreation Plan. 31/ Unless otherwise noted, all facilities listed are available for public use. Locations of the 27 sites listed are shown on Figure 12.

Both districts offer numerous facilities of great size and capacity, although waterfront facilities are few in number due to the lack of useable beach areas. The Hamakua District provides ample local and neighborhood resources, while the South Kohala District offers limited neighborhood recreation areas. Inland sites are numerous and offer varied activities, although no major inland water facilities are developed.

31/ Reference 42.



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HAMAKUA FOREST RESERVE
FOREST RESERVE
KOHALA
NORTH KOHALA
SOUTH KOHALA
KOHALA MTS
KAWAIHAE-WAIMEA RD.
Waimea
Kawaihae
Kawaihae Harbor
KAWAIHAE BAY
Waialoula
Puako
Kalahuipuaa
Anaehoomalu
Anaehoomalu Bay
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Kiholo Bay
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SADDLE ROAD
NORTH HAMAKUA
SOUTH HAMAKUA
HAWAII COUNTY
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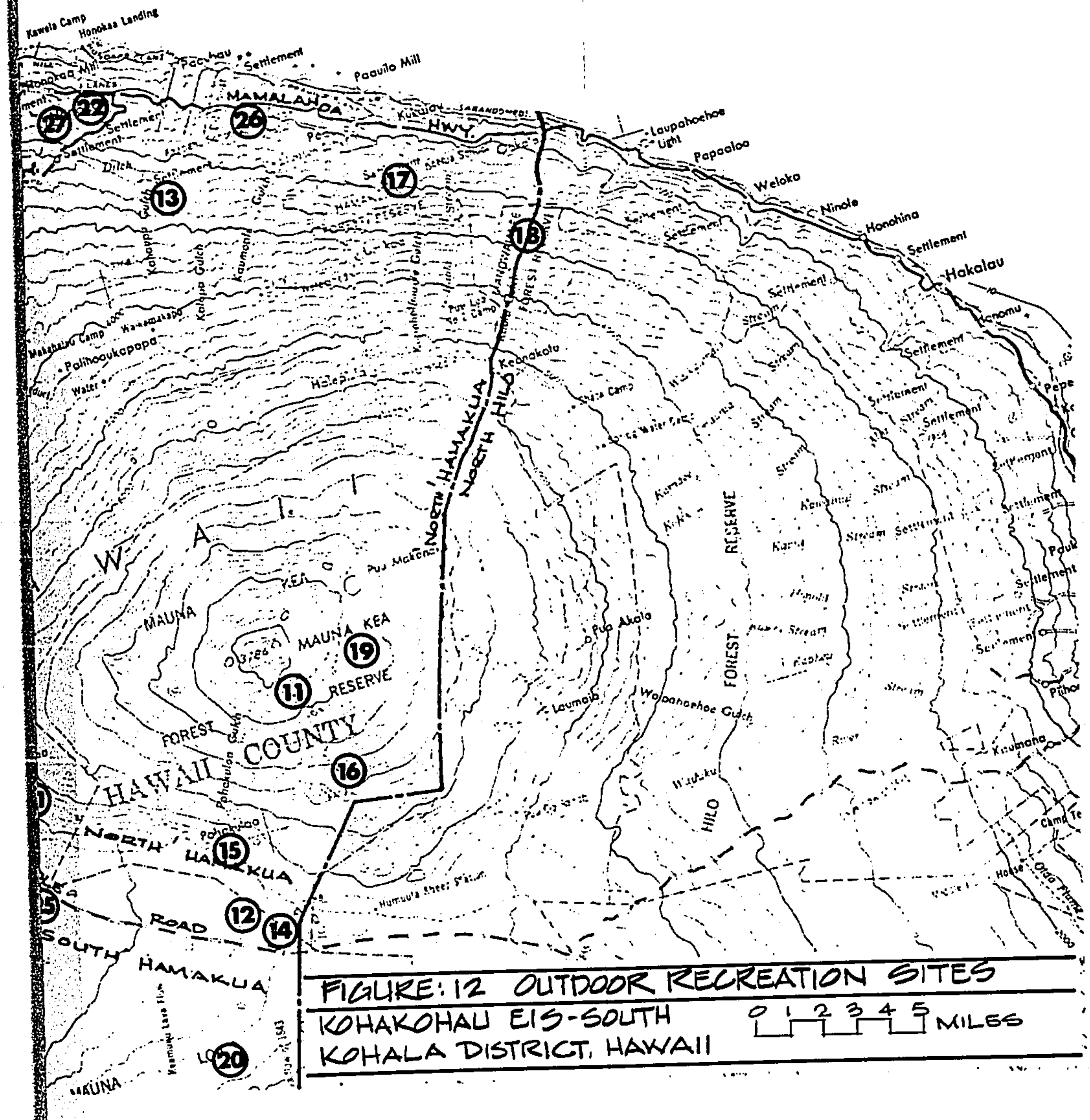


FIGURE: 12 OUTDOOR RECREATION SITES
KOHAKOHAU EIS-SOUTH KOHALA DISTRICT, HAWAII

Table 5

Outdoor Recreational Sites, South Kohala and Hamakua Districts

Location and Name of Site	Administering Agency	Acreage	Comments
South Kohala District			
1. Hapuna Beach State Park	State Division of Parks	300	Lodging, camping, surfing, swimming.
2. Kohala Forest Reserve	State Division of Forestry	23,800	Camping, trails, portions restricted.
3. Kawaihae Boat Harbor	State Division of Harbors	246	Marina, boat ramp, fishing.
4. Puako Launching Ramp	State Division of Harbors	0.5	Boat ramp, fishing.
5. Samuel A. Spencer (Kawaihae) Park	County of Hawaii	13.4	Camping, surfing, swimming.
6. Waimea Park	County of Hawaii	6.4	Town park, picnicing, tennis.
7. Waimea Park Site	County of Hawaii	2.8	Mountain hiking.
8. Equestrian Center	Boise-Cascade	---	Under construction
9. Mauna Kea Beach Hotel Golf Course	Private	---	
10. Parker Ranch	Private	---	

Table 5, continued

Hamakua District				
11.	Mauna Kea Adz Quarry	State Division of Parks	---	Under construction
12.	Pohakuloa Military Camp	U. S. Army	---	Restricted to military, guests. Mountainous area.
13.	Kalopa State Recreation Area	State Division of Parks	100	Forest area, camping, lodging.
14.	Mauna Kea State Park	State Division of Parks	700	Mountain area, lodging, camping, hiking, skiing.
15.	Pohakuloa Area	State Division of Parks	500	Mountain area, lodging, camping, hiking.
16.	Hale Pohaku Area	State Division of Parks	200	Mountain area, lodging, camping, hiking.
17.	Hamakua Forest Reserve	State Dvision of Forestry	4,633	Forest area, camping, hiking.
18.	Manowaialee Forest Reserve	State Division of Forestry	1,410	Camping, hiking, picnicing.
19.	Mauna Kea Forest Reserve	State Division of Forestry	87,150	Lodging, camping, hiking.
20.	Manua Loa Forest Reserve	State Division of Forestry	160,470	Hiking, picnincing.
21.	Kaohe House Pasture Game Management Area	State Division of Fish and Game	6,440	Mountain area, hiking.
22.	Honokaa Swimming Pool	County of Hawaii	---	Swimming

Table 5, Continued

23.	Waipio Valley Lookout Point	County of Hawaii	1.4	Mountain Area, hiking.
24.	Camp Hanokaia	Boy Scouts of America	240	Camping.
25.	Camp Kilohana	Girl Scouts of America	6.0	Camping.
26.	Camp Mekokiko	The Methodist in Hawaii	---	Lodging, camping.
27.	Hamakua Country Club	Private	---	

7 - Aesthetic/Amenity Considerations

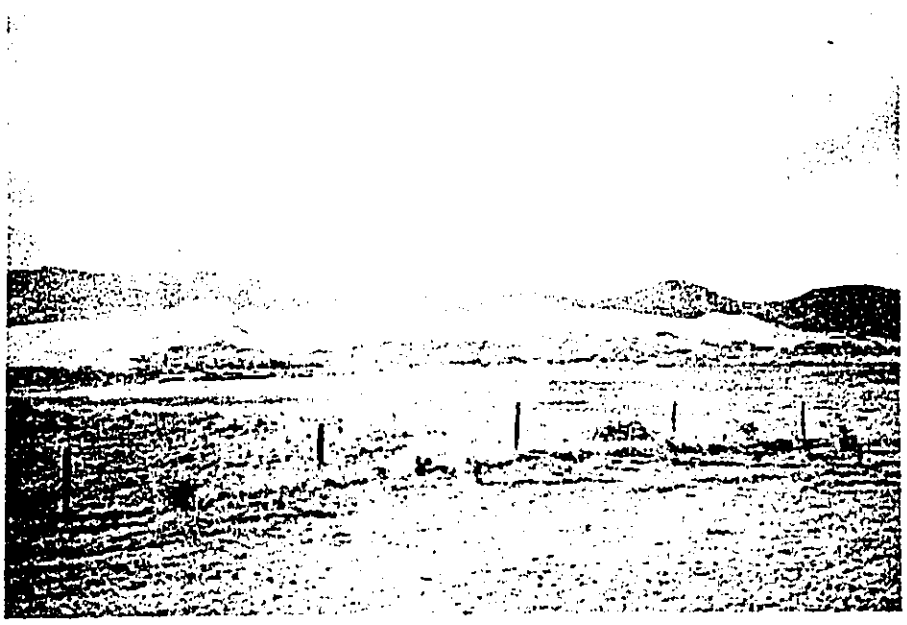
The South Kohala District exhibits three distinct visual environments. The Waimea area is characterized by green rolling hills and grazing lands. The western coastal plain, in contrast, exhibits an arid, desert-like landscape with white sand beaches and blue ocean. The Kohala Mountains display grass-covered foothills and densely overgrown subtropical conditions at the higher elevations where average annual rainfall approaches 200 inches.

The Kohakohau Dam Project study area is located within the latter visual environment. Figure 13 shows three views of the potential project area: (A) from within the potential zone of inundation looking through the main saddle toward Waimea and Mauna Kea, (B) along the Kohakohau Stream bed, and (C) looking toward Waimea from the Kamuela Airport area. Within the study area, as located in Figure 4, the visual character is comprised of densely overgrown vegetation on the slopes of Kohala Mountain. A few waterfalls and pools, such as is shown in Figure 13, exist along the Kohakohau Stream bed but are virtually inaccessible. The dense tropical nature of the study area is undiscernable from populated and distant locations.

The Waimea Town area is characterized by the tranquil atmosphere of a small community located within a diversified natural setting. The capability of the Kamuela Airport to accommodate jet aircraft has, perhaps, resulted in the most significant intrusion on the apparent leisurely pace of the area.

(A) Looking south through main saddle toward Waimea.

(B) Along the Kohakohau Stream bed.



(C) Looking toward Waimea from Kamuela Airport area.

FIGURE: 13
KOHAKOHAU EIS

PHYSICAL SETTING

For purposes of identifying existing physical conditions in the potential project area, the study area as shown in Figure 4 has been divided into the five sub-areas shown in Figure 14. These sub-areas correspond with potential zones of construction as follows:

Sub-Area 1: The potential Upper Hamakua Ditch (UHD) Diversion channel location, a section approximately 20 feet wide and 7,000 feet long.

Sub Area 2: The zone of inundation and fill, approximately 135 acres in the ultimate development alternative and 90 acres in the initial development alternative. Inlcudes the areas filled for the main and saddle dams.

Sub Area 3: The area below the primary dam in which the spillway and access roads would be constructed. Includes strips in a gross area of approximately 80 acres.

Sub Area 4: The potential outlet pipe area, a section approximately 20 feet wide and 4,000 feet long.

Sub Area 5: The potential rock quarry area of approximately 40 acres.

Discussions of existing physical conditions refer to these sub-areas as follows.

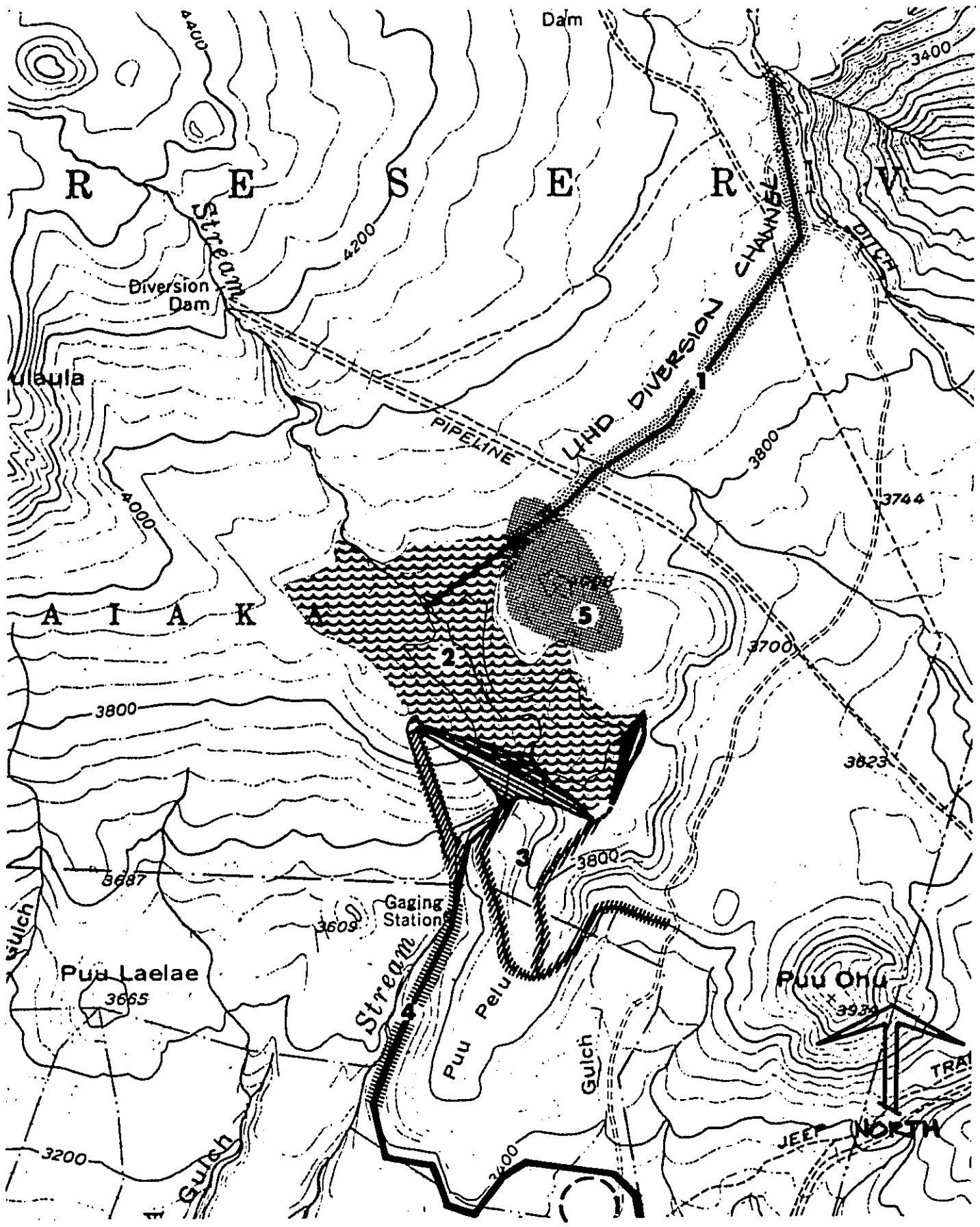


FIGURE : 14 PROJECT SUB-AREAS

KOHAKOHALI EIS - SOUTH
KOHALA DISTRICT, HAWAII

500 0 500 1500 FEET

8 - Topography, Geology, and Soils

A - Topography

Figure 15 shows elevation contours and locations of prominent topographic features on the island of Hawaii. Located on the southern slopes of the Kohala Mountains, the study area exhibits relatively steep slopes in the higher elevations and gentle slopes and rolling hills in the lower elevations near Waimea town. The Kohakohau Stream flows on fairly low gradients in the upper reaches as it enters the study area, exhibits a series of small pools and waterfalls as it flows through the potential reservoir area, and then changes its course and flows over much steeper gradients and waterfalls between the potential damsite location and the existing Kohakohau Diversion (see Figure 5).

B - Regional Geology

The island of Hawaii was formed by the action of the five volcanoes shown in Figure 15: Kohala and Mauna Kea, which have not erupted in historic time; Mauna Loa and Kilauea, which are still active, and Hualalai, which last erupted in 1801. Each volcano has an independent geologic history which explains many currently observable characteristics. The older southern slopes of Kohala Mountain have been buried beneath Mauna Kea lavas, resulting in the reduction in area covered by Kohala lavas to the present 5.8 per cent of the island's total acreage.

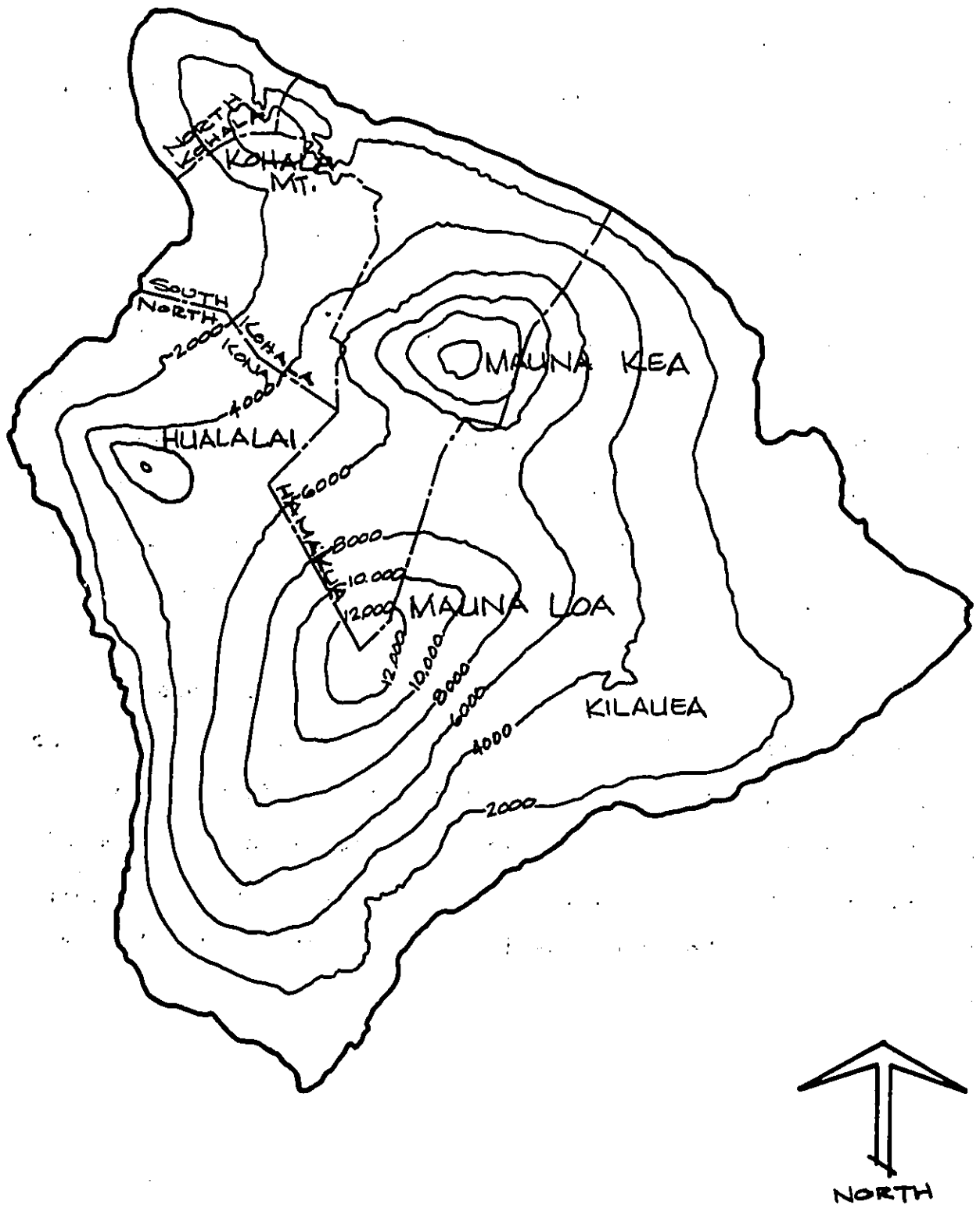


FIGURE: 15 TOPOGRAPHY, ISLAND OF HAWAII

KOHAKOHAU EIS-SOUTH
KOHALA DISTRICT, HAWAII

10 5 0 5 10 15 MILES

Kohala Mountain was built up by the rapid outpouring of Pololu series lavas during Tertiary time. These lavas left rocks which are predominantly olivine basalt. After the eruption of this series, the windward (northeastern) slopes of Kohala Volcano were deeply eroded, leaving deep gorges which include Waipio Valley. Renewed activity resulted in the eruption of andesite and trachyte lavas known as the Hawi series. These flows rest on the soils formed on top of the Pololu Series lavas and are found in the windward valleys cut by earlier erosion. Subsequent erosion and weathering have cut relatively shallow valleys into the lee (southern) slopes of Kohala Mountains and deeper valleys in the previously eroded windward slopes, and have formed existing soils.

Numerous dikes are suspected to cut the lavas in the central part of the mountain. The extensive erosion on the windward slopes has exposed these dikes in the deep valleys, but the limited erosion on the southern slopes has not exposed such dikes. The older (Pololu) lava beds are generally highly permeable, while the later (Hawi) lava beds are generally hard and dense, with shallow soil cover.

C - Study Area Geology

The potential project area was studied in 1964 and a report 32/ was prepared based on a series of test borings made in the study area. The 1970 Feasibility Report 33/ interpreted those findings and presented the following summary of geologic conditions at the potential damsite.

> "The damsite and reservoir area are covered by dense tropical vegetation. Swampy areas are prevalent throughout the reservoir area. The existence of perennial ponds in Kohakohau Stream and the saturated swampy areas in the reservoir indicate low permeability of the soil cover and underlying rock. The stream lies above the natural groundwater table and, consequently, the water table will not provide a source of water for the reservoir.
>
> The right (west) abutment is a long narrow ridge of trachyte which forms a very steep gorge within 100 feet in elevation of the streambed. This portion of the abutment was too steep to be accessible during the field reconnaissance. The rock should be generally hard and dense with joint spacing averaging about one foot. Overburden on the upper slope above elevation 3,720 feet is estimated to be between three and six feet deep.
>
> The valley bottom at (the site) is very narrow with steepwalled sides. The stream competely fills the gorge, and there is a waterfall just downstream of the dam axis. At the dam axis and downstream, sound and hard trachyte-andesite will be exposed for the dam structure. Upstream from the dam axis, overburden consisting of residual soil and recent alluvium occurs to an estimated depth of five to 20 feet. A fault is thought to occur in the streambed, but is not expected to adversely affect a dam at this site.
>
> The left (east) abutment of the dam is on dense, sound trachyte. Overburden is absent or very shallow below elevation 3,760 feet, while above this elevation overburden may be as much as 20 feet of organic swampy, saturated, residual soil.

32/ Reference 37.
33/ Reference 36.

A saddle dike is required on the left abutment for any dam higher than an elevation of 3,820 feet. The dike foundation would be sound to moderately-weathered trachyte. Organic, swampy soil varying from three to 20 feet deep overlays the bedrock. A fault is thought to cross the dike axis near its left side, but it is considered to have no effect on the stability of the dike." 34/

Generalized geology at the potential project site is shown in Figure 16. Seepage would be expected to occur at various rock outcrops in the reservoir area, and the abutments would require grouting to limit leakage. No known mineral resources are located in the area.

34/ Ibid, page III-7.

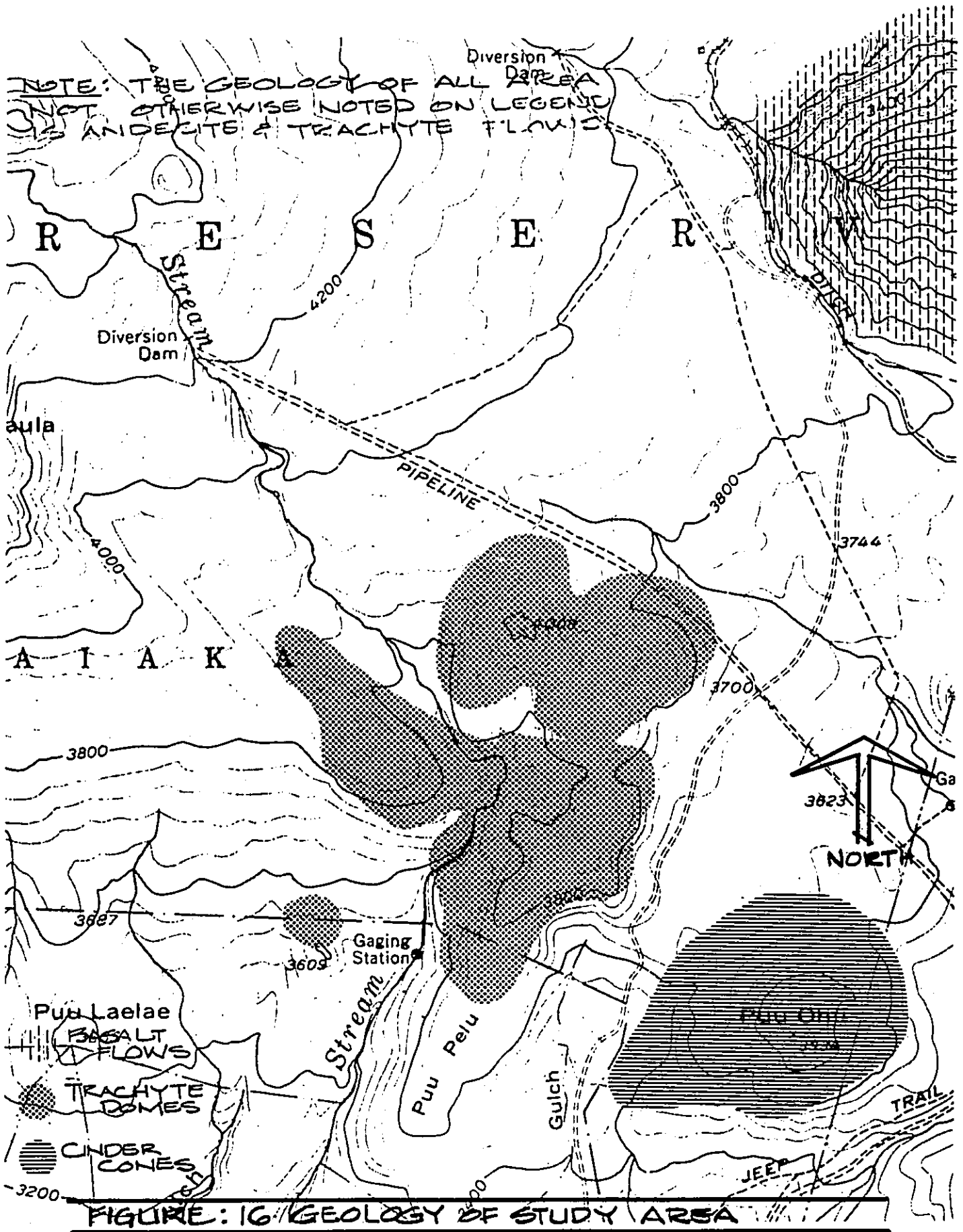


FIGURE: 16 GEOLOGY OF STUDY AREA

KOHAKOHAU E16-SOUTH
KOHALA DISTRICT, HAWAII

D - Soils

Overburden in the study area ranges in depth from a few feet to over twenty feet. Overburden in the valley floor consists primarily of highly organic, saturated soils which are thought to average 2 to 3 feet in depth. Overburden occurring in the Kohakohau Stream bed consists of boulders, cobbles, gravel, and alluvium. Swampy areas, as shown in Figure 23, exhibit deeper overburden mantles. The right and left dam abutments are overlain with variable depths of similar materials.

Soil in the area has been identified as a clay silt with a low relative permeability. Short periods of high rainfall and runoff have resulted in somewhat alluviated streambed conditions. The grass cover in these reaches is perennial.

No significant erosion or sedimentation is present along the Kahakohau Stream bed or below the potential damsite location. During intense rainstorms, however, peaty and organic material is washed from the drainage shed and discolors the stream waters, as is discussed later.

E - Seismicity

Although the study area is not located in a zone of current volcanic activity, earthquakes on the island of Hawaii are relatively frequent and can cause significant damage tens of miles from the epicenter. In additon, several epicenters are located near Waimea.

Sizeable earthquakes have occurred in 1951, 1962, and 1973 on the island of Hawaii. The 1951 earthquake, registering

about 7.0 on the Richter scale, caused extensive damage with its epicenter located south of Kailua. The April 1973 earthquake caused an estimated $5.5 million total damage, much occurring along the Hamakua Coast as the epicenter was located north of Hilo. Although the epicenter of that earthquake was located near Hilo, the Mauna Kea Beach Hotel, located on the western coast approximately 40-50 miles from Hilo, reportedly sustained appreciable structural damage.

The entire island of Hawaii is designated as a Zone III earthquake hazard area (most severe of the four zones used) by the U.S. Geological Survey.

9 - Climatology, Air, and Noise

A - Climatology

The highest average rainfall in northern Hawaii occurs at the summit of Kohala Mountian, as shown in Figure 17. Within the vicinity of the study area, a number of rainfall gaging stations have been installed since 1950 but many were removed or suffered equipment failures. Consequently, no long-term record of rainfall is available for the Kohakohau Stream watershed. A rainfall gaging station with a relatively long record (27 years) is located on the Waikoloa Stream approximately one mile from the proposed dam site, and other stations with reliable records are located near Waimea and the summit of Kohala Mountain. From these stations of long record were inferred the iso-hyetal lines (lines showing locations of equal annual rainfall) for the northwest portion of the island of Hawaii shown in Figure 18. As shown, the project study area receives about 75 inches of rainfall annually.

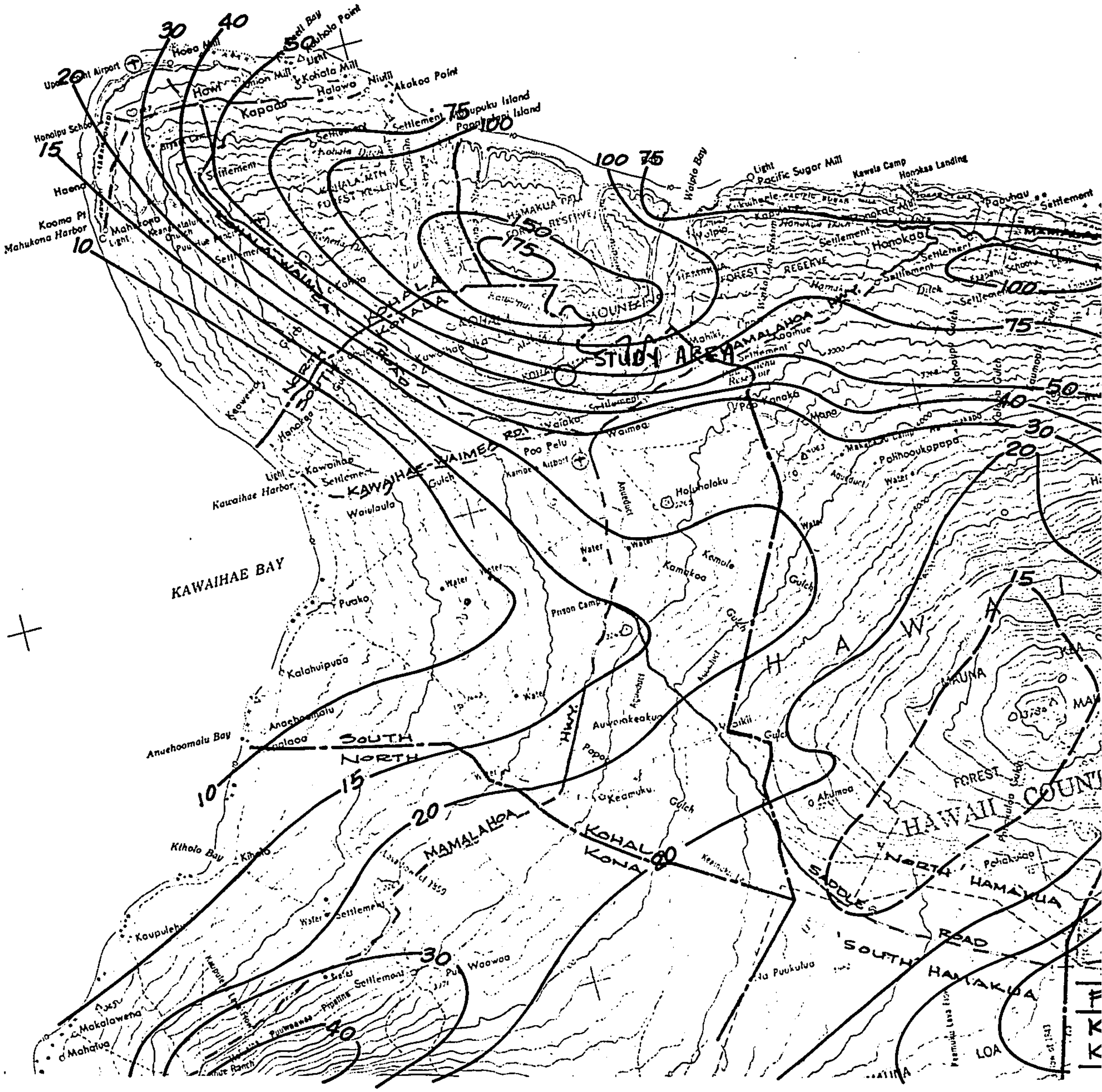
B - Air Quality and Noise

The atmosphere in the immediate vicinity of the potential project area is virtually unaffected by human activities. No background noise or air pollution levels are noticeable within the Kohala Forest Reserve area north of Waimea. The town of Waimea and immediate surroundings exhibit similar conditions, only slightly influenced primarily by automobile traffic and airport activities. No air emmission or noise monitoring stations are located in the district.

FIGURE: 17 MEDIAN ANNUAL RAINFALL, ISLAND OF HAWAII

KOHAKOHAU EIS - SOUTH
KOHALA DISTRICT, HAWAII

5 0 5 10 15 20 MILES



STUDY AREA
KAWAIHAE BAY
Kawaihae Harbor
Mahukona Harbor
Koama Pt
Honoipu School
Upolu Point Airport
Kohala Mill
Halawa
Niulii
Akokoa Point
Kapaau
Hawi
Paauhau
Pacific Sugar Mill
Honokaa
Honokaa Landing
Kawela Camp
Waipio Bay
Waipio
Kukuihaele
Mahiki
Waimea
Waiaka
Poo Pelu
Puu Kanaka
Holoholoku
Kawaihae
Waiulaula
Puako
Kalahuipuaa
Anaehoomalu Bay
Anaehoomalu
Kiholo Bay
Kiholo
Kaupulehu
Makalawena
Mahaiula
Puu Waawaa
Auwaiakeakua
Keamuku
Prison Camp
Kamakoa
Kamuela
Ahumoa
Palihookapapa
KAWAIHAE-WAIMEA RD.
KOHALA
KONA
SOUTH
NORTH
MAMALAHOA
SADDLE ROAD
NORTH HAMAKUA
SOUTH HAMAKUA
HAWAII COUNTY
FOREST RESERVE
MAUNA
LOA
10
15
20
30
40
50
75
100
175

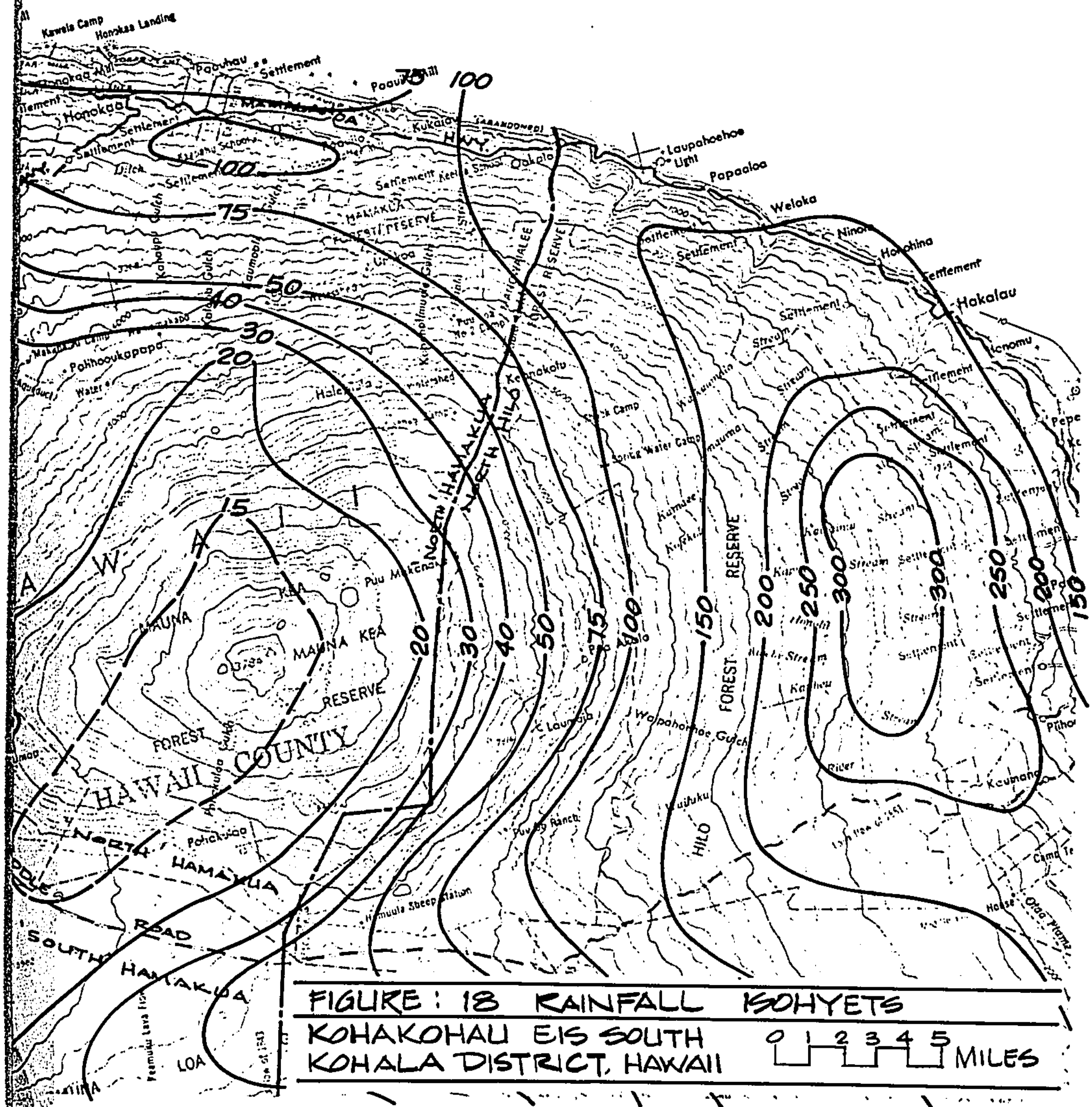


FIGURE: 18 RAINFALL ISOHYETS
KOHAKOHAU EIS SOUTH
KOHALA DISTRICT, HAWAII

10 - Floral Features of the Ecosystem

A study of vegetation in the study area has been conducted by Dr. Derral Herbst, assistant researcher at the Harold L. Lyon Arboretum in Honolulu, Hawaii. His complete report is presented in Appendix A, from which the following remarks are taken.

In Sub-Area 1, the proposed Upper Hamakua Ditch (UHD) Diversion Channel would pass through an open boggy region of low trees and shrubs. Stunted Metrosideros and Cheirodendron with Vaccinium calycinum, tree ferns, Clermontia and Styphelia are the dominant shrubs. Sphagnum moss covers the ground and forms humps around the bases of the shrubs. Disturbance, primarily by pigs, has allowed hilo grass, Juncus and other exotic weeds to gain a foothold in the area, and are now a very common component of the vegetation.

The proposed Kohakohau Reservoir (Sub-Area 2) lies in a middle elevation, wet forest. In general, the vegetation can be characterized as a sparse growth of tree ferns, shrubs and stunted trees. The ground cover consists of a great number of species of ferns, grasses, sedges and herbs, the majority of which are weeds of wide distribution. The moss, Sphagnum palustre, is abundant, forming thick mats on the ground and hummocks at the bases of the trees.

The dominant trees are Metrosideros and Cheirodendron, two of the most common genera in our native forests. Along the steep banks of the Kohakohau Stream, which roughly bisects the reservoir site, there is a luxuriant stand of these trees, most

reaching 25-30 feet in height. At the other extreme, those on the flat bottom land of the reservoir are sparse and stunted, while the ones growing on the slopes of the puus and ridges enclosing the area are somewhat intermediate in size and number.

Tree ferns and occasional small trees and shrubs grow throughout the area. These form a sparse understory along the banks of the stream; elsewhere they are usually about the same height as the Metrosideros and Cheirodendron. The native Rubus, Vaccinium and two species of Myrsine are the most common shrubs and small trees. Less common are Coprosma, Ilex, Gouldia, Pelea, and Clermontia.

The ground cover is comprised primarily of Sphagnum moss and exotic herbs. Pig damage in the area is quite extensive. The disturbance they have created and, it is suspected, the seeds they have carried, have resulted in a nearly totally exotic groundcover vegetation. Ginger, probably washed down by the stream, forms a dense, rank growth along the streams' steep slopes. Weedy herbaceous plants and native and exotic grasses and sedges are found in and along the stream. An aquatic moss grows abundantly among the rocks in the stream bed. Juncus and clumps of grasses and sedges are common in the bottom lands of the reservoir where the ground is covered by a thick mat of Sphagnum. The slopes of the enclosing ridges have patches of Dicranopteris; other ferns are scattered throughtout the area. Hilo grass is one of the main ground covers and is mixed with other grasses, sedges, Juncus, Hydrocotyle, Erechtites, Eupatorium, Veronica and other herbs. The wetter, more protected,

areas have large pathces of Sphagnum while Cuphea, Drymaria, Vaccinium berberifolium and Hypochoeris replaces the moss on barer, more exposed slopes. Ploygonum is common in shallow, muddy pig "wallows."

In summary, the trees and shrubs in Sub-Area 2 are all native, but common, species, while the ground cover consists primarily of Sphagnum and common weeds of disturbed areas.

In Sub-Area 3, the proposed access road passes from the existing jeep trail into a narrow strip comprised primarily of exotic trees: Eucalyptus, Alnus, and Melaleuca with an occasional Metrosideros or Cheirodendron mixed in. Just after starting into the native Metrosideros-Cheirodendron forest, the road turns abruptly southward into a cleared pasture.

The right fork of the access road passes through the grassland and back into the riprap area. It first passes through a small Cryptomeria grove, then enters a native forest similar to that along the northern side of the area.

The left fork continues through the pasture, then along the west slope of Puu Pelu to the axis of the proposed dam. The western slope of Puu Pelu supports the best native forest sampled, Metrosideros and Cheirodendron are the dominant trees. The shrub and small tree story is botanically richest here. Cyrtandra and Couldia hillebrandii are included along with Ilex, Coprosma, Couldia terminalis, Vaccinium, Cibotium and others. The ground may be bare or have a light litter cover or it may have a rich covering of native ferns, mosses, sedges or liverworts. Occasionally a small patch of exotic herbs is encountered.

Dicranopteris covers the strip along the fence line in many places, and is common near the crest of the puu. The epiphytic flora is very rich: Ophigolossum and Psilotum complanatum are common as is Astelia, Elaphoglossum spp. and filmy ferns. Polypodium pellucidum is a common epiphytic and terrestrial species in this area, especially along the top of the steep bank of the stream.

The proposed spillway would descend the steep bank to the Kohakohau Stream from the western side of the proposed Kohakohau Dam axis. The vegetation of this area consists of a tall (+ 40 feet), open Metrosideros and Cheirodendron forest. Cibotium is common and ginger, palm grass and some Eupatorium cover the lower part of the bank and line the stream.

The proposed outlet pipe (Sub-Area 4) would follow the Kohakohau Stream. The vegetation of the stream banks is as that described above.

In Sub-Area 5, the vegetation of the south and south-western slopes is similar to that found on the upper slopes in Sub-Area 2. Metrosideros and Cheirodendron are present in intermediate size and number.

In conclusion, the study area has for years been a buffer zone between cleared, planted pasture land and the bogs of Kohala. Forestry plantings have been made within the site. A jeep road passes through it. A lane for a pipeline was cleared along its northern side and a row of Eucalyptus was planted in the lane. Pig damage is extensive throughout the site. An introduced ornamental (ginger) has heavily infested the stream

banks.

In general, the dominant arborescent vegetation consists of a sparse, stunted stand of Metrosideros and Cheirodendron trigynum trees. Metrosideros is the most abundant tree in the Hawaiian Islands, while Cheirodendron trigynum is a very common species found on all of the main islands except Kauai. The shrubs and small trees as Cibotium, Ilex, Vaccinium, Sadleria and Gouldia are common on all or most of the main islands. No varieties or forms of these species ae restricted to this small area or to its immediate environs. Some of the species, as the Cyrtandra, are endemic to the Island of Hawaii but are rather widespread throughout the island or throughout the Kohala Mountains. The native ferns, epiphytes and groundcovers are mostly rather commons sorts. The groundcover consists primarily of weedy herbaceous plants, indicating the amount of disturbance which has occurred in the area.

None of the native species observed is rare in the islands today. No species listed on the tentative rare and endangered species list for the State was observed in the study area. A checklist of species observed is presented in Appendix A.

11 - Faunal Features of the Ecosystem

A study of birds and mammals in the study area has been conducted by Dr. C. R. Eddinger, Instructor in Biology, Honolulu Community College. A study of aquatic life in the study area has been completed by the State of Hawaii, Department of Land and Natural Resources, Division of Fish and Game. These complete reports are presented in Appendix A, from which the following remarks are taken.

A - Birds

Seven species of birds were observed in the study area: (1) Apapane, (2) Hawaii Amakihi, (3) Hawaii Elepaio, (4) Koloa, or Hawaiian Duck, (5) Japanese White-eye, (6) Chinese Thrush and (7) Ring-necked Pheasant.

The Apapane (Himatione sanguinea sanguinea) is the most common of the surviving species of Hawaiian Honeycreepers. Today the Apapane is rare at elevations below 2,800 feet, and typically prefers trees that are at least 25 feet high.

The Hawaii Amakihi (Loxops virens virens) is endemic to the island of Hawaii and is the second most common living honeycreeper. The Amakihi is abundant on Hawaii, Maui, and Kauai, and is typically found inforests of mixed endemic and introduced trees.

The Hawaii Elepaio (Chasiempis sandwichensis sandwichensis) is endemic to the island of Hawaii, and, like the Amakihi, can be found in forests of mixed endemic and introduced trees.

The Koloa or Hawaiian Duck (Anas wyvilliana) was originally found on all the main islands except Lanai and Kahoolawe. The Koloa became extinct on all of the islands except Kauai, probably as a result of the introduction of the mongoose, and is now considered an endangered species. A propagation program at Pohakuloa has resulted in a number of pen-reared birds being released on Oahu and Hawaii.

The Japanese White-eye (Zosterops japonica japonica) was imported from Japan in 1929 and spread from Oahu to the neighbor islands. The White-eye can inhabit almost any habitat type and is by far the most abundant species of any in the islands. White-eyes may actually compete with endemic birds and may be responsible for the spread of bird malaria.

The Chinese Thrush (Garrulax canorus) was introduced to Hawaii in about 1900. The Chinese Thrush prefers low dense vegetation and is at home in many introduced plant thickets.

The Ring-necked Pheasant (Phasianus colchicus torquatus) was introduced as a game bird in about 1865 and is primarily found in open grasslands.

Sub-Area 1, along the proposed UHD Diversion Channel, is not an abundant wildlife area. The Japanese White-eye was the only species observed.

The most common birds in the proposed reservoir area (Sub-Area 2) are, again, the Japanese White-eyes. Two Koloa Ducks were observed in flight over the area but did not alight within the potential zone of inundation. Because the vegetation is generally scrubby within the area, the Apapane, Amakihi, and

and Elepaio are considered uncommon.

Sub-Areas 3 and 4 exhibit mixed vegetation and are inhabited mainly by Japanese White-eyes.

Sub-Area 5 contains mixed vegetation and is inhabited by Japanese White-eyes and a few Apapanes and Amakihis.

In summary, the most commonly observed bird species was the Japanese White-eye, which is abundant throughout the islands. Some Apapanes, Amakihis, and Elepaios, the three endemic species, were observed in the study area and are typically found in areas of mixed endemic and introduced vegetation. These species were observed in greater numbers in the ridges and high slopes surrounding the potential project area. Two Koloas, the only species considered rare or endangered, were observed passing over the study area. Chinese Thrushes and a Ring-necked Pheasant were also observed in the peripheral areas.

The area of greatest concern for wildlife preservation should be the upper slopes and ridges surrounding the dam. These areas are the richest areas in terms of abundance of endemic species, largely because of the height of the vegetation. All species observed, with the exception of the Koloa, are considered common the island of Hawaii and throughout the islands.

B - Mammals

Four mammal species are thought to inhabit the study area: (1) Feral pig (Sus Scrofa), (2) Mongoose (Herpestes aurodunctatus), (3) Black rat (Ratus rattus), and (4) House mouse (Mus musculus). Of these species, none was observed

in the potential reservoir area (Sub - Area 2). All of these mammals were introduced to Hawaii by man. The black rat and mongoose are often predators on birds and their eggs and are considered pests. Rats, mice, and pigs may carry diseases that can be transmitted to man. Extensive damage to native ground cover in the study area has been caused by pigs. None of the species is rare or endangered.

C - Aquatic Life

The aquatic field survey was conducted on March 20, 1974. The stream was in a mild freshet stage at the time (USGS gaging station records show a peak flow of 217 cfs at 1630 hours on March 19, and a flow of 9.2 cfs at 1000 hours on March 20). Collecting materials included a fine-meshed seine and handnet, and a small quantity of rotenone. The use of face-masks for underwater observation was precluded by the turbid waters.

Collecting efforts were confined to a pool and riffles section located just mauka of the potential dam site. Repeated sets of the seine and use of the handnet, and poisoning of a very small pocket of water with rotenone resulted in the collection of only a few chironomid larvae, caddisfly larvae, damselfly nymphs and snails. No other aquatic fauna were collected or observed.

There is no basis for expecting any changes in aquatic faunal conditions without the Project.

Creation of the impoundment will change approximately 3,000 to 4,000 feet of the Kohakohau Stream from a lotic to a lacustrine

habitat for aquatic organisms. This change from a small free-flowing stream to a relatively large area of deep standing water will undoubtedly effect marked qualitative and quantitative alteration of the present aquatic faunal populations. This modification is not, however, deemed to be significantly either detrimental or beneficial.

A potential benefit that may be realized from this Project is the development of a recreational fishery.

D. Summary of the Study Area Ecosystem

The study area supports mixed native and introduced vegetal species which provide habitats for some species of birds and mammals as previously identified. Vegetation in the potential project area is typical of the Kohala area and the islands. Species present are common to most of the islands, and disturbances by pigs and the buffer zone nature of the area detract from its botanical value. Mammals and birds present are also common to the islands with the exception of the Koloa (duck). No fish life is present in the Kohakohau Stream system.

Figure 19 shows primary ecological zones in the study area, generally corresponding to the upper slopes and ridges surrounding the potential dam and reservoir. Vegetation is generally higher and less disturbed in these zones, which represent primary wildlife areas as well. The total area shown is approximately 75 acres, representing 7.5 percent of the gross study area and less than one percent of the total area of the Kohala Forest Reserve. Based on the evaluations performed, vegetation and habitats in the study area are not considered unique, and the present ecosystem is capable of absorbing disturbances and maintaining present populations by replacement of wildlife species to adjacent habitat areas.

Impacts of the Kohakohau Dam Project to the ecosystem of the study area are identified in following discussions in terms of changes in existing surface conditions, effects on vegetation and habitat areas, and resulting impacts to faunal species.

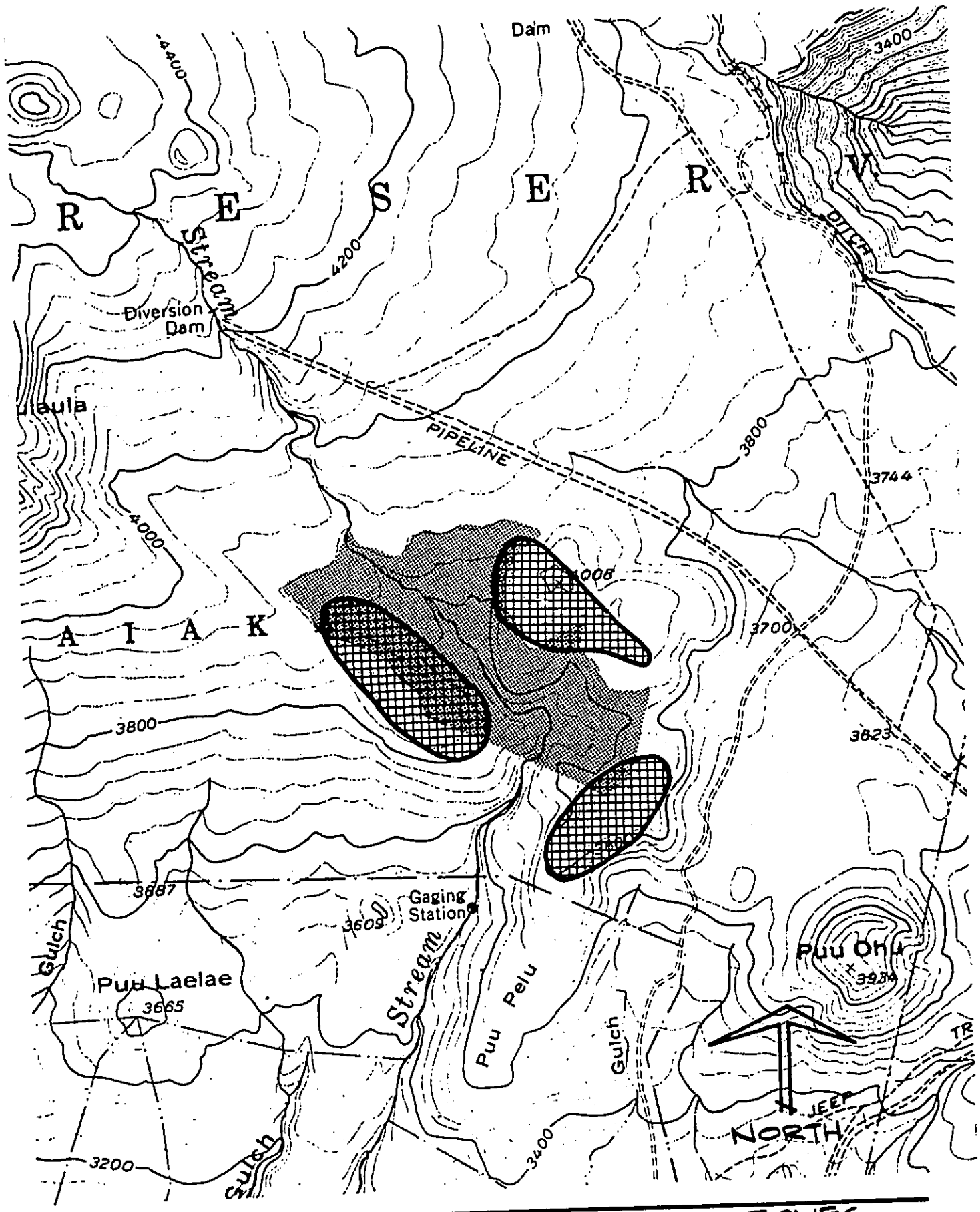


FIGURE: 19 PRIMARY ECOLOGICAL ZONES
KOHAKOHAU EIS - SOUTH
KOHALA DISTRICT, HAWAII

500 0 500 1500 FEET

12 - Surface Waters

A - Drainage and Stream Flow

The lee slopes of the Kohala Mountains are drained by several intermittent streams which flow through the Waimea area and turn westward toward Kawaihae across the permeable lava flows of Mauna Kea. Primary streams in the study area vicinity are the Kohakohau, Alakahi, and Waikoloa Streams as shown in Figure 20. The Waikoloa Stream has caused flooding within the town of Waimea during high intensity storms when runoff overflows the narrow and winding stream channel. The Kohakohau Stream exhibits similar tendencies but has caused only minor damage in the past.

Figure 20 shows the locations of stream gaging stations in the vicinity of the study area, and a summary of records since 1950 is presented in Table 6. Data for station 7560 give the best indication of normal Kohakohau Stream flows, although a pipeline diverts water at an elevation of approximately 4,250 feet for the Parker Ranch System (see Figure 9). As is indicated in Table 6, mean annual streamflow in the Kohakohau Stream is 6.17 MGD at station 7560 and 6.94 MGD at station 7565, but the variation between years is quite high. Figure 21 gives a historic comparison of rainfall and streamflow at station 7570 on the Waikoloa Stream. As shown, the streamflow pattern generally corresponds with the rainfall pattern over the same period, and the extreme variations in rainfall and streamflow can occur within periods of one or a few years. Variations in flows of Kohakohau

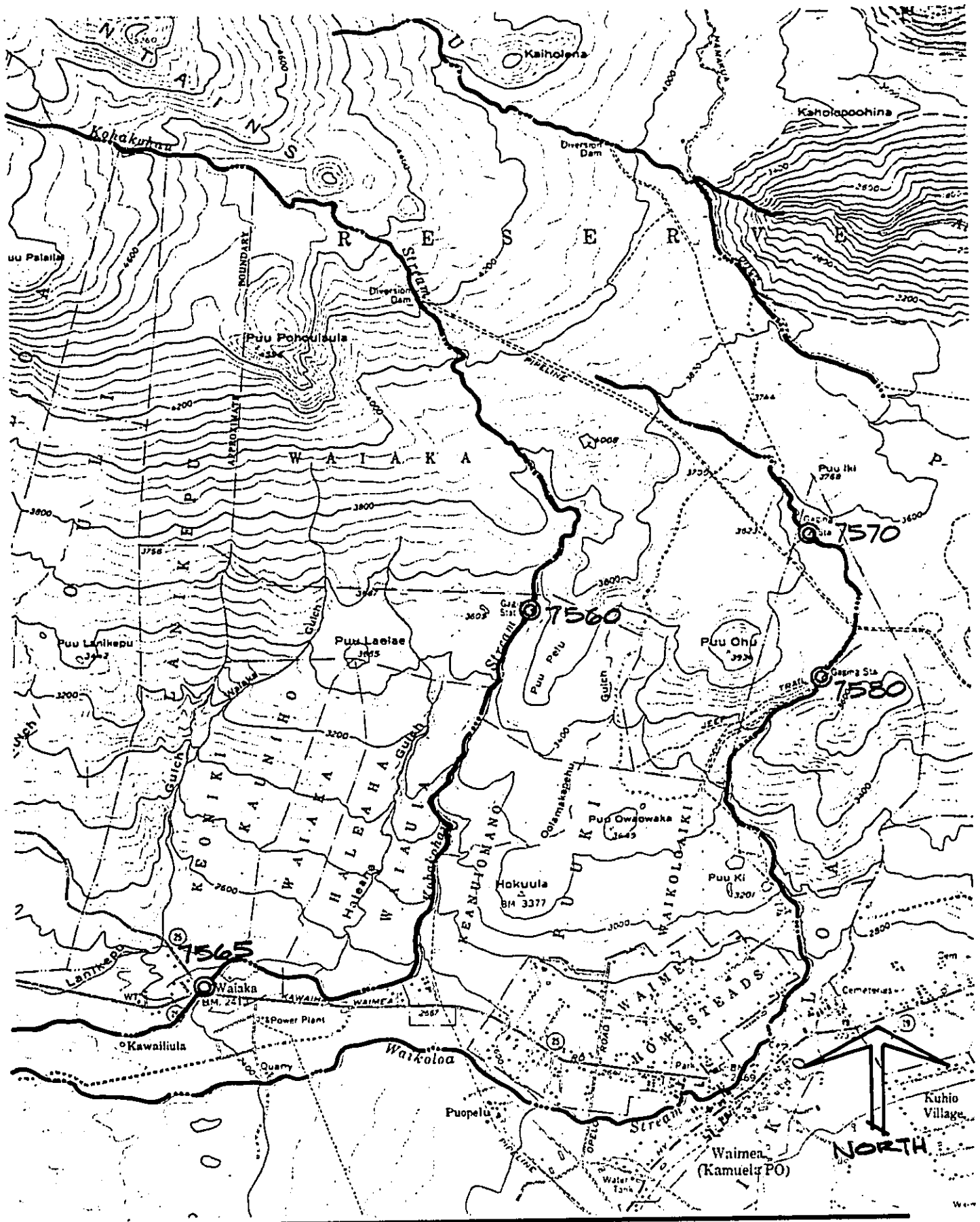


FIGURE: 20 STREAMS & GAGING STATION LOCATIONS

KOHAKOHAU EIS - SOUTH
KOHALA DISTRICT, HAWAII

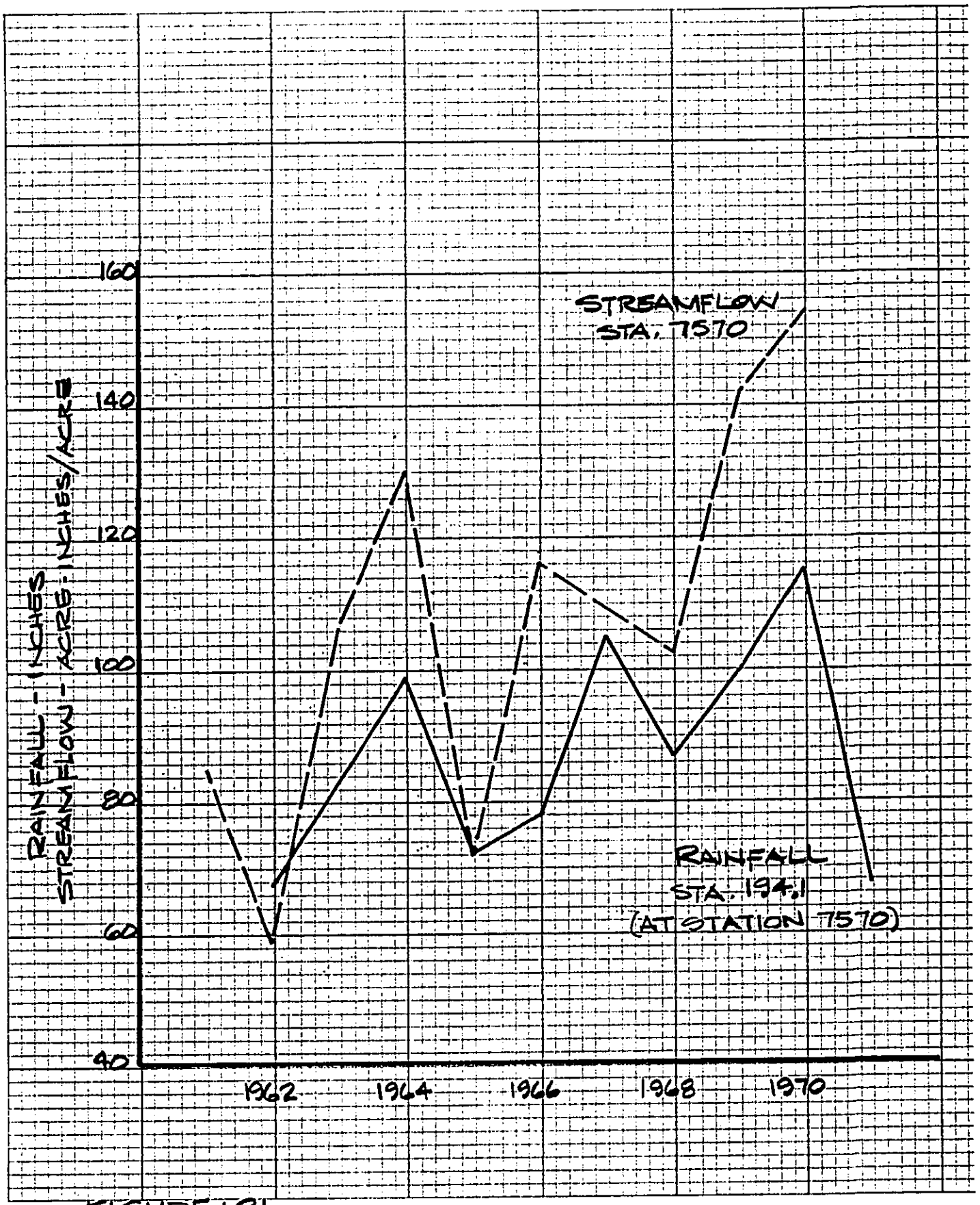


FIGURE: 21

RAINFALL & STREAMFLOW, UPPER WAIKOLOA STATION, 1960-1970

KOHAKOHAU EIS- SOUTH
KOHALA DISTRICT, HAWAII

Table 6

Streamflow Summary, 1950-1970

Station Number	Kohakohau Stream 7560	7565	Waikoloa Stream 7570	7580
Drainage Area (Mi^2)	2.51	4.30	0.78	1.18
Elevation	3,273	2,410	3,570	3,460
Average Annual Streamflow (mgd) 1950	--	--	5.94	7.62
51	--	--	3.46	4.22
52	--	--	5.58	7.59
53	--	--	4.19	5.07
54	--	--	5.50	6.66
55	--	--	4.98	6.14
56	--	--	4.87	6.74
57	6.14	--	4.79	6.44
58	11.05	--	6.60	8.80
59	8.34	--	5.31	7.04
1960	8.05	--	5.14	6.47
61	4.65	--	3.15	3.76
62	1.91	--	2.17	2.50
63	4.33	--	3.97	4.62
64	6.19	8.02	4.82	5.65
65	3.11	2.82	2.71	3.05
66	5.43	5.30	4.33	5.25
67	6.45	6.65	4.04	5.00
68	5.01	6.20	3.80	5.02
69	7.05	8.23	5.24	6.78
1970	8.54	11.38	5.74	7.78
Mean annual (mgd)	6.17	6.94	4.59	5.82
Mean daily (cfs)	9.13	10.1	7.13	8.38
Max daily (cfs)	3880	3540	1930	3390
Min daily (cfs)	0	0	0.74	0.59

Stream are similar.

The Kohakohau Stream watershed extends to about elevation 5,100 feet near the summit of Kohala Mountain. The main channel is above known groundwater levels and does not receive dike-confined water. Ground cover in the watershed consists of brush, trees, and sphagnum moss in the higher elevations and contributes to high runoff. At about elevation 3,600 feet the ground cover changes to primarily grass, which increases infiltration and decreases runoff.

B - Water Quality

Waters of the streams in South Kohala generally exhibit high water qualities suitable for potable waters with the exception of conditions of high color and peaty taste. Although inland surface waters in Hawaii are not individually classified by the State, all surface waters used for water supplies fall into the Class I category, as does the Kohakohau Stream. It is the objective of this class of waters that sources remain in as nearly the natural state as possible with minimal pollution from any source. 35/ Table 7 gives Hawaii State water quality standards for Class I waters. 36/

Kohakohau Stream waters are treated at the County plant below the existing Kohakohau Stream Diversion and storage reservoirs (see Figure 8). The County Department of Water Supply makes periodic chemical analyses of water sources in use for domestic supplies, from which the representative sampling profile of water quality in the Kohakohau Stream given in Table 8 is taken.

35/ Reference 29.
36/ Ibid.

Table 7

Class I Water Quality Standards, Hawaii

Parameter	Standard
1. Coliform Bacteria	The median coliform bacteria shall not exceed 100 per 100 ml, nor shall more than 10% of the samples exceed 2,400 per 100 ml during any 30-day period.
2. Fecal Coliforms	Fecal coliform content shall not exceed an arithmetic average of 200 per 100 ml during any 30-day period, nor shall more than 10% of the samples exeed 400 per 10 ml in the same time period.
3. PH	Not more than ½ unit difference from natural conditions but no lower than 7.0 nor higher than 8.5 from other than natural causes.
4. Nutrient Materials	Total phosphorus, not greater than 0.050 mg 11. The naturally occurring atomic ratio of NO_N to PO_4-P M a body of water will be maintained.
5. Dissolved Oxygen	Not less than 6.0 mg/1.
6. Temperature	Temperature of receiving waters shall not change more than $1.5^{o}F$ from natural conditions.
7. Turbidity	Secchi disc or secchi disc equivalent as "extinction coefficient" determinations shall not be altered from natural conditions more than 5%.
8. Radionuclides	No radionuclide or mixture of radionuclides shall be present at concentrations greater than those specified by the U.S. Public Health Service for drinking water.

Table 8

Summary of Water Quality Characteristics, Kohakohau and Waikoloa Streams

Parameter	Unit	Stream and Sampling Date	
		Kohakohau 6/21/72	Waikoloa Range from 1966 - 1968
pH @ 30°C	---	---	5.8 to 7.9
Color	---	---	22 to 320
Odor	---	---	---
Turbidity	---	---	0 to 100+
NO_2	ppm	0.01*	---
NO_3	ppm	0.01	0.5 average
Hydroxide Alkalinity	ppm as $CaCO_3$	---	---
Carbonate Alkalinity	" " "	---	---
Bicarbonate Alkalintiy	" " "	---	---
Total Alkalinity	" " "	---	10.0 to 24.0
Total Hardness	" " "	---	12.0 to 28.0
Total Solids	ppm	50	60.0 to 360.0
Loss on Ignition	"	20	---
SI_2	"	2.0	12.0 average
Fe^2	"	0.41	0.12 average
Ca	"	0.16	2.1 average
Al	"	3.2	---
Mg	"	2.0	2.4 average
SO_4	"	2.6	---
Na	"	4	---
K	"	0.2	---
Chlorides	"	7.0	5.0 average
As	"	0.005*	---
F	"	0.10	---
Mn	"	0.03*	---
Pb	"	0.005*	---
Cu	"	0.02*	---
Zn	"	0.02	---
Se	"	0.01	---
Phenols	"	---	---

*Less Than

Also shown in Table 8 are ranges in water quality parameters observed in the Waikoloa Stream from 1966 to 1968, which are typical of conditions in Kohakohau Stream as well.

Although no specific standards regulating temporary disruptions of water qualities, such as could occur during construction activities, exist for inland waters in Hawaii, it is well to consider Class I standards as objectives in limiting discharges from any sources.

13 - Ground Water

Ground water on Hawaii occurs in three distinct forms: (1) high-level perched ground water, (2) high-level ground water impounded by dikes, and (3) low-level, or basal, ground water. Occurrences of ground water are closely associated with geologic characteristics of an area. On the windward slopes of Kohala Mountain, high-level ground water is released by numerous springs flowing in the deep canyons. Although high-level ground water is also thought to underly the southern slopes of Kohala Mountain, little physical evidence supporting those predictions has been documented to date. Basal ground water is considered extensive in both areas. Figure 22 shows existing wells, tunnels, and springs in Kohala and Hamakua. 37/

A - Ground Water in the Potential Reservoir Area

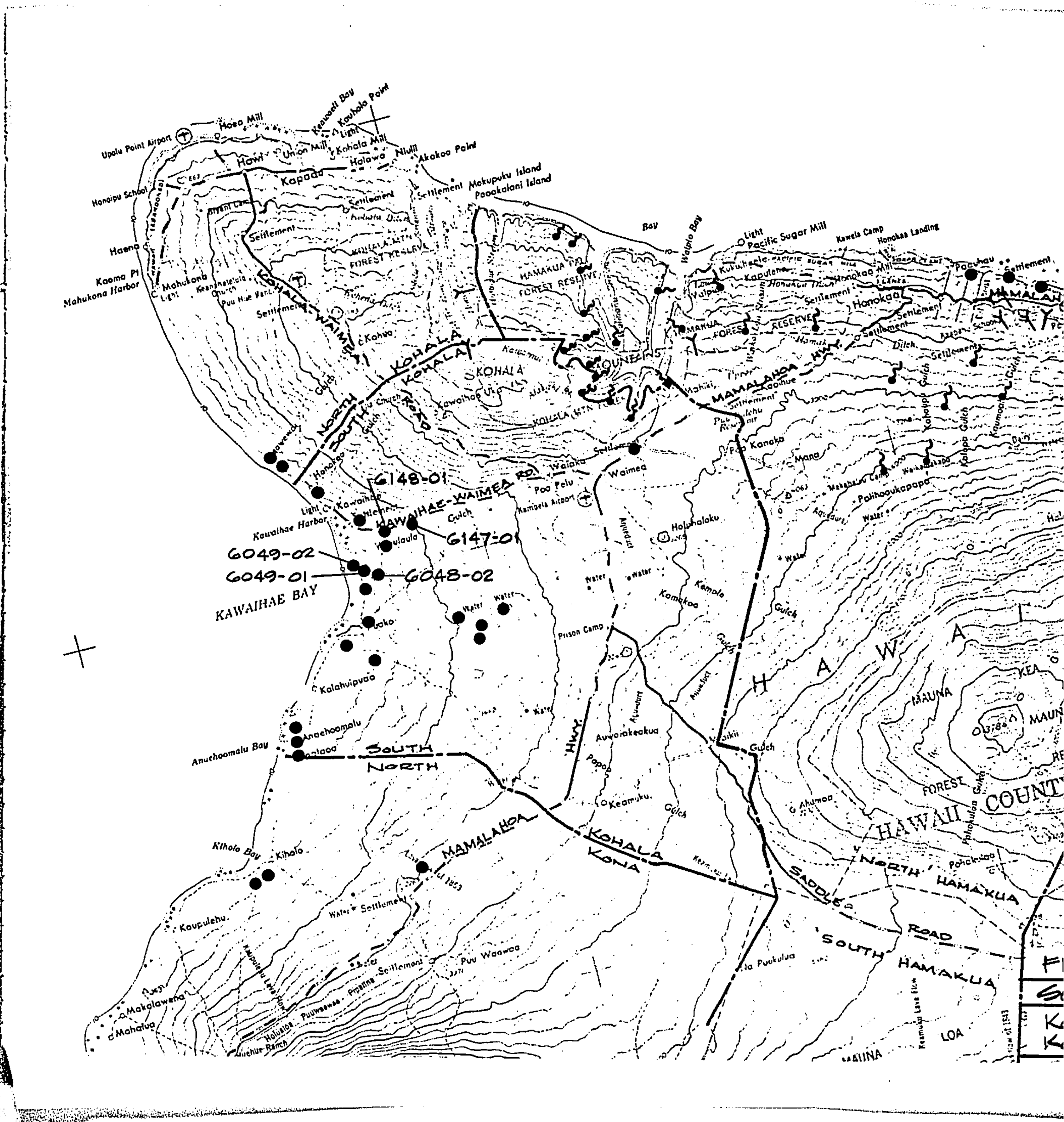
Beds of ash and soil and dense lava flows generally have low permeability and are barriers to the downward movement of water. Ground water perched on these barriers occurs in discontinous, generally thin zones that supply springs and seeps on slopes and outcrops. Volumes and discharges of perched ground water bodies fluctuate greatly with rainfall. Swamps are bodies of perched ground water which are poorly drained and are typified by spongy and saturated masses of muck and vegetation.

Swampy areas were identified in the study area as shown on Figure 23. Based on information obtained from a 1964 boring program in the study area, 38/ the general reservoir

37/ Based on data from References 32 and 41.
38/ See Reference 37.

area is believed to be situated in the valley of a stream which contributes water to the zone of ground water below stream level.

The identification of possible zones of permeable materials underlying surface soils and vegetation, and the knowledge that the general water table is well below the Kohakohau Stream elevation, indicate that there is expected to be some reservoir leakage to the ground water table.



Upolu Point Airport
Hoea Mill
Kauhola Point
Union Mill
Kohala Mill
Hawi
Halawa
Niulii
Akakoa Point
Kapaau
Honoipu School
Settlement
Mokupuku Island
Paaakalani Island
Haena
Kaoma Pt
Mahukona
Mahukona Harbor
Bay
Waipio Bay
Light
Pacific Sugar Mill
Kawela Camp
Honokaa Landing
Paauhau
Honokaa Mill
Honokaa
FOREST RESERVE
KOHALA
NORTH
SOUTH
KOHALA
MAMALAHOA
HWY
Waimea
Kamuela Airport
Poo Pelu
Waiaka
KAWAIHAE-WAIMEA RD.
6148-01
6147-01
6049-02
6049-01
6048-02
Kawaihae Harbor
KAWAIHAE BAY
Puako
Kalahuipuaa
Anaehoomalu
Anaehoomalu Bay
SOUTH
NORTH
Prison Camp
Holoholoku
Kamakoa
Kemole
Gulch
Aqueduct
Keamuku
Popoo
HWY.
Kiholo Bay
Kiholo
MAMALAHOA
KOHALA
KONA
Settlement
Kaupulehu
Puu Waawaa
Makalawena
Mahaiula
H A W A I
MAUNA KEA
HAWAII COUNTY
FOREST
NORTH
HAMAKUA
SADDLE
ROAD
SOUTH
HAMAKUA
MAUNA
LOA

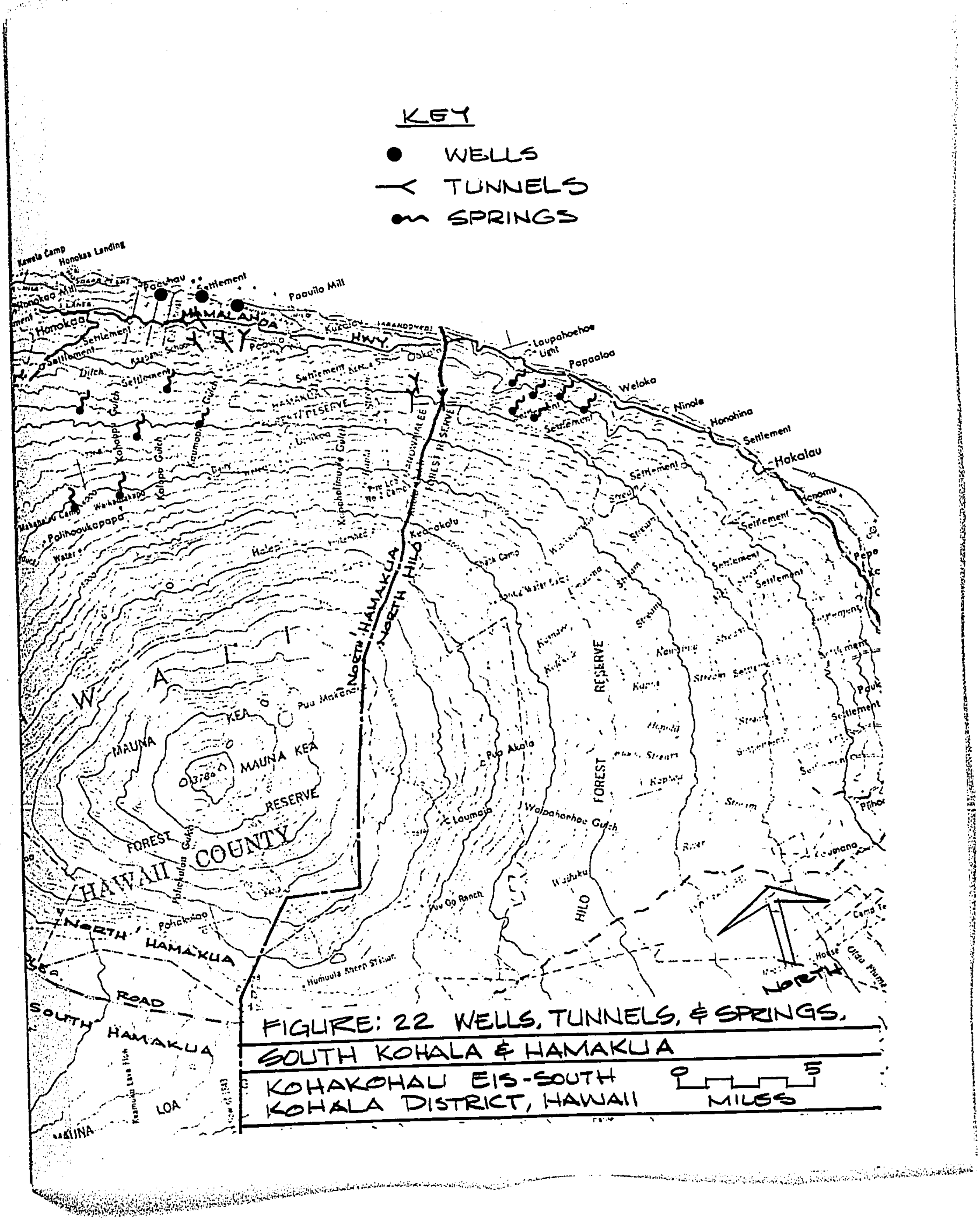


FIGURE: 22 WELLS, TUNNELS, & SPRINGS.
SOUTH KOHALA & HAMAKUA
KOHAKOHAU EIS-SOUTH KOHALA DISTRICT, HAWAII

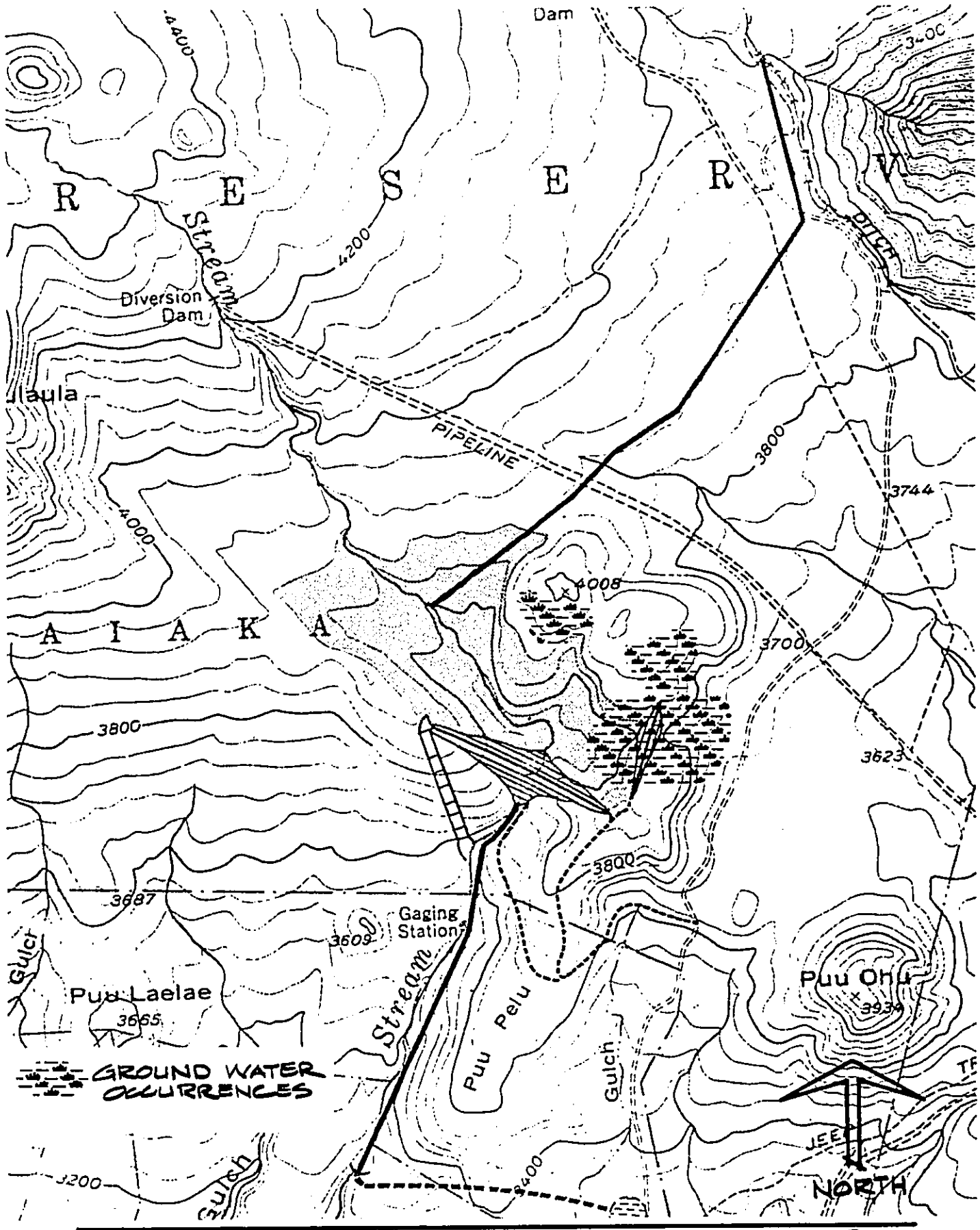


FIGURE: 23 GROUND WATER OCCURRENCES IN STUDY AREA

KOHAKOHAU EIS - SOUTH
KOHALA DISTRICT, HAWAII

B- Ground Water Impounded by Dikes

Dikes cutting the lavas underlying the upper slopes of Kohala Mountian impound large quantities of ground water. On the windward slopes, the water appears at springs in valleys eroded into the dike compartments. On the lee slopes, however, erosion has not been so severe, and, because deep valleys have not been formed to intersect the suspected dike compartments, visible evidence of the existence of diked ground water is not present.

It is thought that a large volume of water may be stored on the southern side as well above that elevation. 39/ A well drilled near Waimea at approximate elevation 2,600 feet, however, intercepted no high-level ground water in a drilling depth of about 800 to 1000 feet. Other wells drilled near Waimea have similarly encountered no dike-confined ground water to depths approaching elevation 1500 to 1800 feet. Additional discussion of dike-impounded water is presented in the comparison of alternatives to the Kohakohau Dam Project.

C - Basal Ground Water

Basal ground water is the large body of water that lies near sea level, below the upper water table. The upper zone of basal water is a lens of fresh to brackish water which floats on the heavier sea water. The fresh lens is generally maintained by infiltration from rainfall on the land area overlying the lens.

As shown on Figure 22, numerous wells in western South

39/ Reference 39.

Kohala have been drilled to tap basal water. Wells located within one to two miles of the coastline generally yield brackish water (above 250 ppm chlorides), but two wells drilled at approximate elevation 1,200 feet by Boise-Cascade have yielded waters with much lower (20-30 ppm) chloride contents. Basal ground water is less likely to be affected by saltwater intrusion with increased distance from the coastline, but accessibility in inland areas is limited by great pumping head requirements.

D - Ground Water Quality

High-level ground water typically exhibits high qualities. The color and peaty taste of surface waters have been removed by infiltration processes. Basal ground water in coastal areas, however, is susceptible to contamination from salt water intrusion.

Table 9 presents water quality profiles for selected sampling points in South Kohala, 40/ corresponding with well numbers shown on Figure 22. Supplies obtained from brackish wells generally contain between 250 and 500 ppm chlorides, compared with the County of Hawaii Department of Water Supply potable limit of 180 ppm.

40/ From Reference 32.

Table 9

Summary of Ground Water Quality Characteristics

Parameter	Sampling Site and Date				
	No. 6048-02 1968	No. 6049-01 1968	No. 6049-02 1968	No. 6147-01 1963	No. 6148-01 1972
pH 25°C	--	--	--	7.3	--
pH 30°C	--	--	--	--	--
Color	--	--	--	5	--
Odor	--	--	--	--	--
Turbidity	--	--	--	1	--
Nitrates	--	--	--	.001	Nil
Nitrites	--	--	--	2.89	.78
Hydroxide Alkalinity	--	--	--	--	--
Bicarbonate Alkalinity	--	--	--	89	--
Total Alkalinity	--	--	--	89	--
Total Hardness	188	204	466	214	180
Toatal Solids	868	973	2322	796	860
Loss on Ignition	--	--	--	240	220
Silica	12.5	12.6	12.4	89.2	8.8
Iron	Nil	.22	Nil	.04	.68
Aluminum	--	--	--	.05	.14
Calcium	27	28	52	31.5	32
Magnesium	27	33	82	32.8	30
Sulfate	82	91	192	54	70
Sodium	239	274	695	135	175
Chlorides	383	443	1180	250	340
Arsenic	--	--	--	Nil	Nil
Fluoride	--	--	--	.20	.26
Manganese	Nil	Nil	Nil	.05	.03
Lead	--	--	--	Nil	Nil
Copper	--	--	--	.13	.02
Zinc	--	--	--	.10	.08
Salenium	--	--	--	Nil	Nil
Phenols	--	--	--	Nil	--

14 - Water Supplies and Demands

As shown in Figure 7, existing domestic water systems in South Kohala and Hamakua include the Kawaihae - Puako, Waimea - Puukapu, and Hamakua Systems. These facilities have been constructed to meet expanding demands as required. At present, there is a slight surplus of domestic supply over current demands; however, recent years have seen temporary shortages in supplies, particularly in the Waimea and Kawaihae areas, in late summer months and other periods of unreliable rainfall. The upper 50-million gallon reservoir, when completed, will serve to provide greater reliability, as well as additional quantity, to the yield of the South Kohala system.

Of the three major agricultural systems shown in Figure 8, only the Hawaiian Irrigation Company system enjoys generally surplus supplies. The Parker Ranch and Lalamilo Irrigation Systems experience droughts correspoding with dry periods in the South Kohala domestic system.

In summary, existing domestic and agricultural water supplies in South Kohala and Hamakua are, with periodic improvements, adequate to meet current levels of domestic and agricultural uses in the districts. Any major increase in demand could not, however, be comfortably accommodated by existing systems.

III. FUTURE ENVIRONMENT WITHOUT THE PROJECT

SOCIO-ECONOMIC CONDITIONS

1 - History and Archaeologic Potential

As no historic or archaeologic sites have been identified in the study area, and as the study area is restricted from public access, no change in the historic and archaeologic character of the study area is expected to occur in the future without the Kohakohau Dam Project.

2 - General Development Patterns

It is expected that the future will see significant growth in the South Kohala District and little change in conditions in the Hamakua District. Conclusions presented in the 1963 General Plan for the Kohala-Hamakua Region, Island of Hawaii 41/ for the 1960's have remained valid today. At that time it was predicted that the sugar industry would continue to decrease employment, the ranching industry would maintain its competitive status, macadamia nut production would increase, diversified farming would substantially increase, industrial activities would grow moderately (primarily at Kawaihae), and the visitor industry would greatly increase in size and influence.

These projections have been generally valid and appear also to apply to the future. Little new activity is

41/ Reference 4.

seen in the Hamakua District, and, at the same time, the long-term decrease in population may be approaching a period of stability. Growth in the South Kohala District is expected; however, the precise scale and rate of that growth are unknown at this time.

3 - Population and Land Use

As shown in Table 10 and on Figure 24, a significant increase in population is expected in South Kohala and Hamakua in the future. Projections shown are based on assumed relationships between economic activity, employment, and population and were prepared in conjunction with the General Plan 42/ in 1971. 43/

Table 10

Projected Population, 1971-1990.

District	1971	1975	1980	1990
South Kohala	2,394	3,700-5,300	8,000-11,700	13,900-22,200
Hamakua	4,795	4,700-4,900	5,100- 5,500	5,900- 7,300
Total	7,189	8,400-10,200	13,100-17,200	19,800-29,500

As indicated by the data and illustrated in Figure 24, either series of projected population growth to 1990 marks

42/ Reference 6.
43/ From Reference 8.

an unprecedented increase in South Kohala and Hamakua. Although the range in projections is large, the envelope shown on Figure 24 represents the most accurate estimates of future population available to date.

Figure 25 shows generalized land use as presented in the General Plan 44/ for the ultimate future condition. When interpreted together, the population projections shown in Figure 11 and the land use projections shown in Figure 25 indicate the general magnitude and direction of growth expected in the South Kohala-Hamakua Region.

Several large developments are planned or are being constructed on private lands within the South Kohala District, primarily along the lee coast south of Kawaihae. In addition to potential private resort and residential developments, there has been substantial interest on the part of various groups in locating other developments in South Kohala. A college facility or branch of the University of Hawaii has been proposed, as well as private and governmental business and research centers. Development of any of these possibilities would significantly affect land use and population trends and distributions within the district.

4 - Economy and Employment

Economic conditions in Hamakua are not expected to change significantly in the short-term future. Agriculture is expected to dominate employment and income characteristics.

44/ Reference 6.

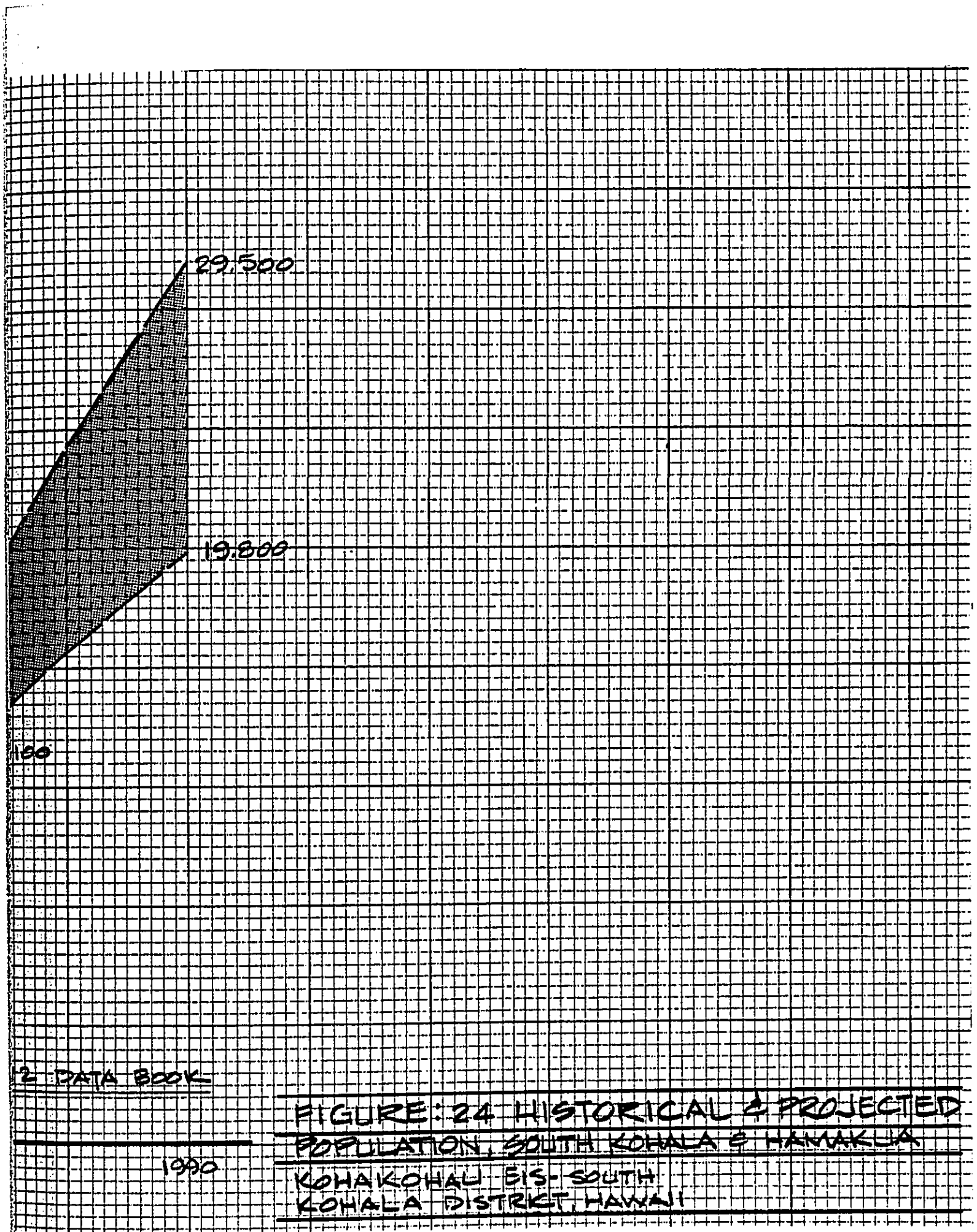
SOUTH KOHALA & HAMAKUA DISTRICTS

32,000
28,000
24,000
20,000
16,000
12,000
8,000
4,000
0

1950
1960
1970
1980
1990

7,561
6,759
6858
8,400
10200
13,100
17,200
19,800
29,50

FROM 1972 DATA BOOK

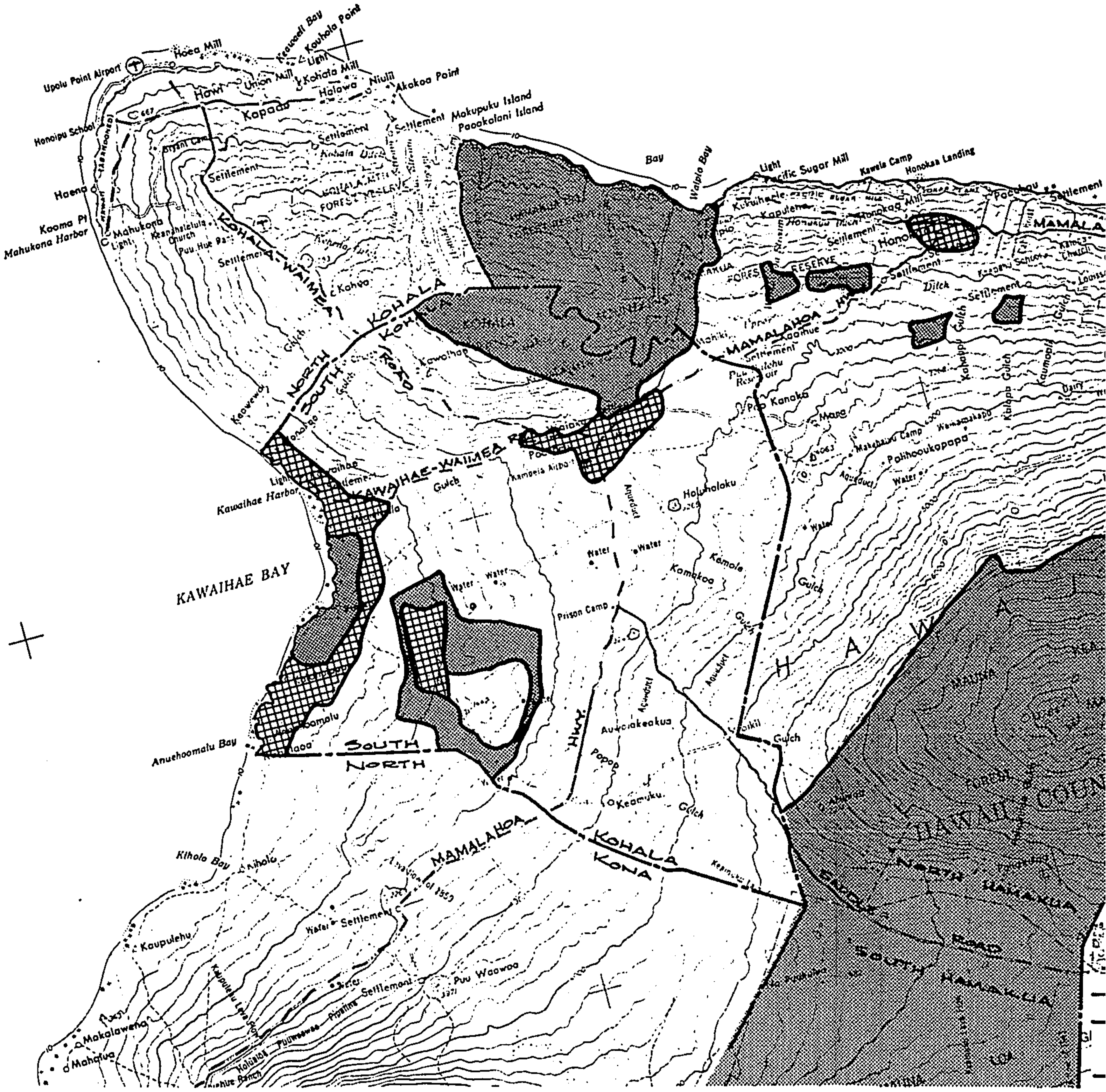


2 DATA BOOK

1990

FIGURE: 24 HISTORICAL & PROJECTED POPULATION, SOUTH KOHALA & HAMAKUA

KOHAKOHAU EIS- SOUTH KOHALA DISTRICT, HAWAII



Upolu Point Airport
Hoea Mill
Kauhola Point
Union Mill
Kohala Mill
Hawi
Kapaau
Halawa
Niulii
Akakoa Point
Makupuku Island
Paaokalani Island
Honoipu School
Haena
Kooma Pt
Mahukona Harbor
Settlement
KOHALA-WAIMEA
NORTH
SOUTH
KOHALA
Bay
Waipio Bay
Light
Pacific Sugar Mill
Kawela Camp
Honokaa Landing
MAMALAHOA
FOREST RESERVE
KAWAIHAE-WAIMEA
Kawaihae Harbor
KAWAIHAE BAY
Holoholoku
Water
Kamakoa
Prison Camp
Auwaiakeakua
Anuehoomalu Bay
SOUTH
NORTH
HWY.
Keamuku
Gulch
Kiholo Bay
MAMALAHOA
KOHALA
KONA
Settlement
Kaupulehu
Puu Waawaa
Makalawena
Mahaiula
NORTH HAMAKUA
SOUTH HAMAKUA
ROAD
HAWAII COUN

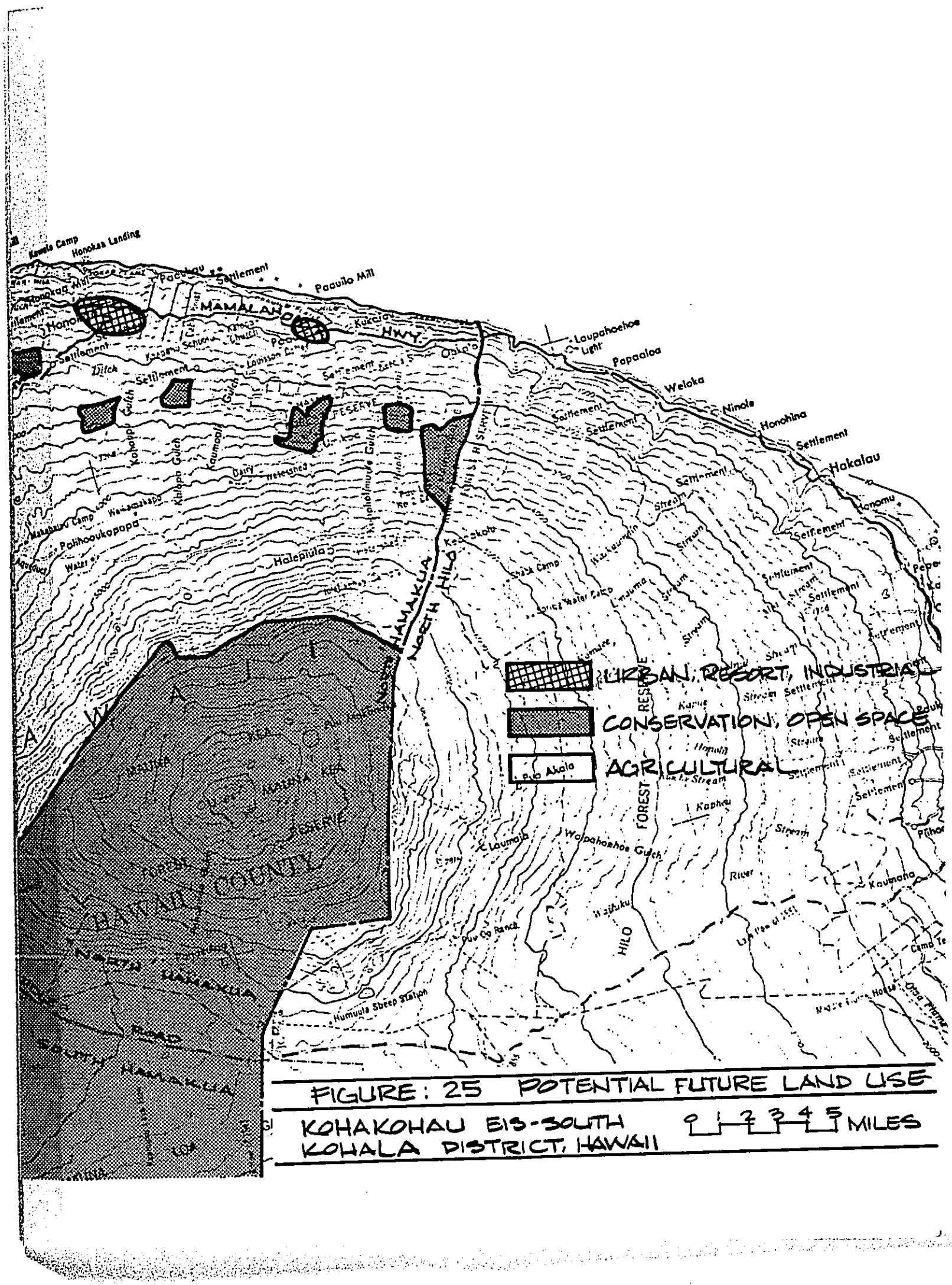


FIGURE: 25 POTENTIAL FUTURE LAND USE

KOHAKOHAU EIS-SOUTH
KOHALA DISTRICT, HAWAII

Potential growth in South Kohala can be expected to spur economic activity in the area and shift labor and income away from agricultural patterns. Realization of (1) the inter-island terminal at Kawaihae, (2) large-scale coastal residential and resort developments, (3) the location of a college branch or research center at Waimea, or other possibilities would dramatically stimulate employment and income in South Kohala. In the absence of substantive plans, however, no preliminary projections can be made.

5 - Power and Transportation

Power consumption and costs are expected to increase in the future from growth in population in the region and increasing fuel costs. The relatively small size and decentralized nature of the population in the South Kohala and Hamakua Districts, coupled with increasingly stringent pollution control standards and rising fuel costs, will mean continued high power costs.

The Waimea-Kona Highway is nearing completion and, when finished, will provide greatly improved accessibility between the two commercial and residential centers. It is expected that a new alignment for the existing Waimea-Kawaihae Road will be completed before 1980.

6 - Recreation

It has been recognized that as development of coastal lands continues, inland parks will be required to

complement heavily used shoreline areas to satisfy both resident and tourist demands. Although the geography and decentralized population distribution in the island of Hawaii limit the accessibility of resource areas, and the use potential of inland areas is not presently realized, future expected growth will open some areas for feasible use. The County of Hawaii Department of Parks and Recreation is preparing a recreation plan for the County of Hawaii which will outline plans for future facilities to complement the resources identified in Table 5 and Figure 13.

7 - Aesthetic / Amenity Considerations

Characterized by natural beauty and serenity, the Waimea area and the Kohala Mountain region offer the privacy and attractiveness of a small community within a diversified natural setting. No significant changes in that condition are expected in the short-term; however, potential long-term growth and development in the South Kohala District would be expected to alter that character to some degree.

PHYSICAL CONDITIONS

8 - Topography, Geology, and Soils

No noticeable changes in existing geologic conditions are expected to occur in the future. Seismic events can be expected to occur in unpredictable frequency and magnitude.

9 - Climatology, Air, and Noise

No significant changes in existing climatological, atmospheric, or background noise conditions are expected in the Waimea area, and no change of any kind is expected in the study area due to access restrictions.

10 - Floral Features of the Ecosystem

No distinct trends in vegetational patterns have been identified in the study area; however, it is thought that the destruction of vegetation by pigs in the study area and the abundance and infestation of exotic, weed-type species will continue to detract from the value of the area as a middle elevation, native forest resource.

11 - Faunal Features of the Ecosystem

Birds and wildlife populations are expected to remain generally stable without the Kohakohau Dam Project, as access to the area is restricted. Continued damage to veg-

etation by pigs in the area may reduce habitats for other mammals and birds.

12 - Surface Waters

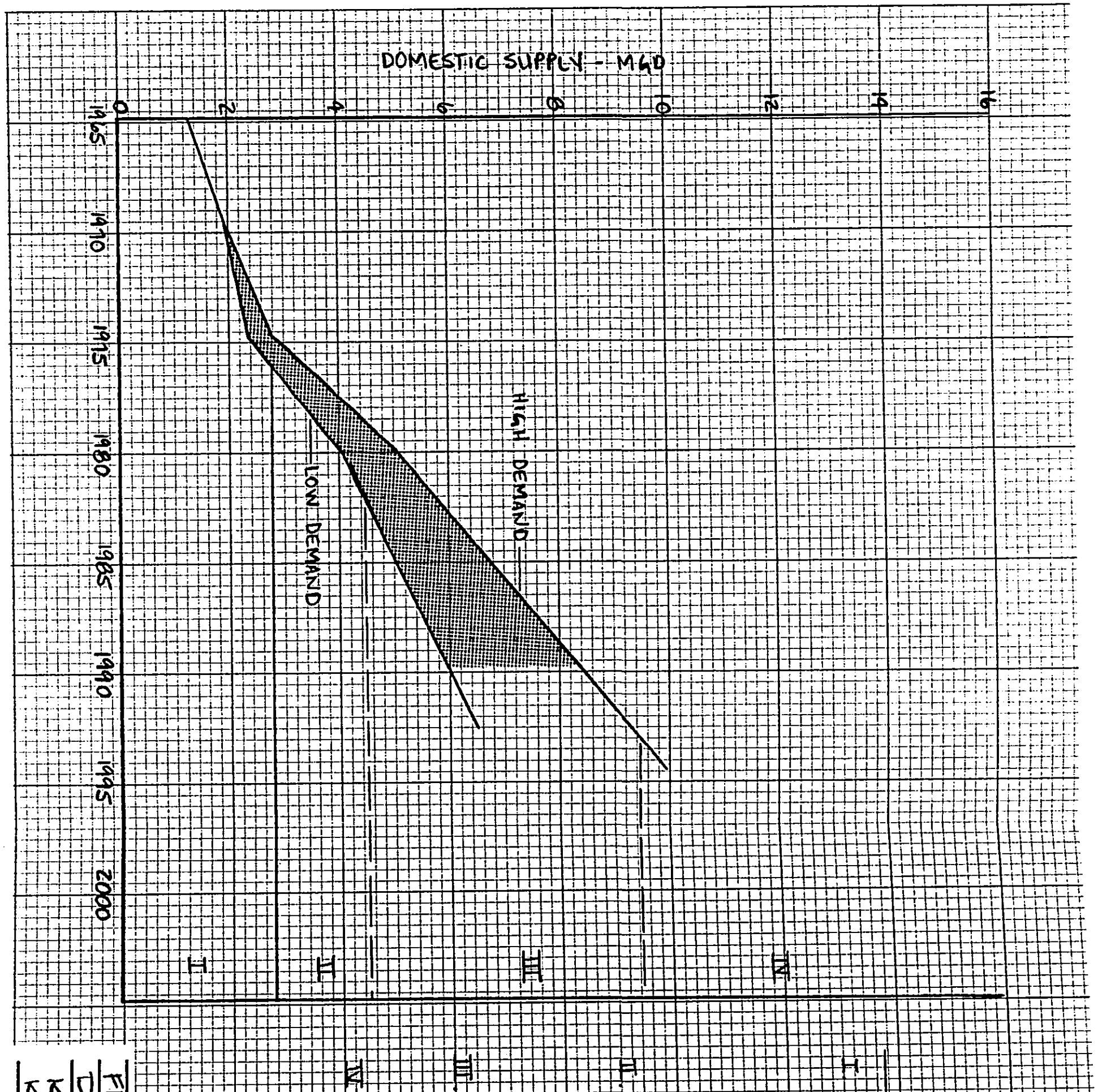
No long-term trends in hydrologic conditions have been identified which would predict future changes in surface water conditions. Stream water qualities are expected to remain stable, as no major activities will affect runoff conditions.

13 - Ground Water

No noticeable changes in qualities, volumes, or discharges of existing ground water bodies are expected to occur in the future. The total estimated draw from wells tapping basal ground water is not expected to result in a reduction in available supplies in the fresh water lens and aquifers, and supplies taken from the more brackish lens will not deplete the reliable yield.

14. Water Supplies and Demands

Figure 26 shows the accumulated development of domestic water supplies in South Kohala and Hamakua, the effects of future water resource development increments and the proposed Kohakohau Dam Project on the total available domestic water supply, and the ranges in projected demands to 1990, based on


DOMESTIC SUPPLY - MGD
0
2
4
6
8
10
12
14
16
1965
1970
1975
1980
1985
1990
1995
2000
HIGH DEMAND
LOW DEMAND
I
II
III
IV
V

	DEVELOPMENT INCREMENT	YIELD (MGD)
IV	I. EXISTING	
	A) WAIKOLOA DIVERSION	1.05
	B) KAWAIHAE WELLS	.33
	C) 50-MG RESERVOIR	1.00
	D) KOHAKOHAU DIVERSION	.40
	SUB-TOTAL	2.78
III	II. FUTURE	
	A) 50-MG RESERVOIR	.10
	B) MIXING WITH COASTAL WELL WATER	1.00
	SUB-TOTAL	1.10
	III. KOHAKOHAU DAM INITIAL STAGE	5.00
	ACCUMULATED TOTAL	9.48
II	IV. KOHAKOHAU DAM ULTIMATE STAGE	5.00
	ACCUMULATED TOTAL	14.48
I		
2000		

FIGURE: 26 DOMESTIC WATER SUPPLY DEVELOPMENT, SOUTH KOHALA

KOHAKOHAU EIS-SOUTH KOHALA DISTRICT, HAWAII

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

	DEVELOPMENT INCREMENT	YIELD (MGD)
IV	I. EXISTING	
	A) WAIKOLOA DIVERSION	1.05
	B) KAWAIHAE WELLS	.33
	C) 50-MG RESERVOIR	1.00
	D) KOHAKOHAU DIVERSION	.40
	SUB-TOTAL	2.18
III	II. FUTURE	
	A) 50-MG RESERVOIR	.10
	B) MIXING WITH COASTAL WELL WATER	1.00
	SUB-TOTAL	1.10
II	III. KOHAKOHAU DAM INITIAL STAGE	5.00
	ACCUMULATED TOTAL	9.48
I	IV. KOHAKOHAU DAM ULTIMATE STAGE	5.00
2000	ACCUMULATED TOTAL	14.48

FIGURE: 26 DOMESTIC WATER SUPPLY DEVELOPMENT, SOUTH KOHALA

KOHAKOHAU EIS-SOUTH
KOHALA DISTRICT, HAWAII

the projected population range shown in Table 10 and Figure 24. As indicated in Increment II, it is intended that the completion of the upper 50 - million gallon reservoir (expected in 1974) would be followed by the mixing of fresh waters with brackish waters from coastal wells to meet increasing demands.

Without implementation of the Kohakohau Dam Project, long-term average daily demands for domestic waters would be expected to be met with existing and planned supplies for a few years. Beyond that time, existing supplies would be insufficient to meet increasing demands.

IV. PROBABLE IMPACT ON THE ENVIRONMENT

Primary and secondary impacts resulting from the Kohakohau Dam Project are discussed for each aspect of the existing environment of the study area and the South Kohala-Hamakua region as follows. The ranking of impacts, following discussions of separate impacts, considers the anticipated magnitude and significance of indirect, as well as direct, impacts.

PRIMARY AND SECONDARY IMPACTS: SOCIO -ECONOMIC

1 - History and Archaeologic Potential

No primary or secondary impacts will result to historic or archaeologic sites as there are no such sites in the study area.

2 - General Development Patterns

The Kohakohau Dam Project will, as a secondary effect of the provision of additional domestic waters, enable the development of planned growth areas in South Kohala and Hamakua as described in the County of Hawaii General Plan. 45/ The project will not induce growth which is incompatible with the General Plan 46/, rather, it will provide an element of the infrastructure of public services required by planned growth in South Kohala and Hamakua. The ultimate level of expected growth and development in South Kohala and Hamakua will not be altered by the Kohakohau Dam Project; however, the provision of a significant surplus in domestic water supply in South Kohala and Hamakua at one time may slightly accelerate the time frame of expected growth.

3 - Population and Land Use

A short term increase in population will occur in South Kohala and Hamakua as a result of the construction period.

45/ Reference 6.
46/ Ibid.

This increase is considered small (less than 5 per cent in Waimea or less than 1 per cent in South Kohala and Hamakua) and will probably occur primarily in the Waimea area. A total of approximately 100 to 150 acres of land in the Kohala Forest Reserve will be converted from the existing condition to a reservoir with attendant facilities, representing less than 1 per cent of the total Forest Reserve acreage and approximately 1.5 per cent of the total Kohala Watershed Reserve acreage. No persons or structures will be displaced by the project.

4 - Economy and Employment

The project will provide a small number of new jobs for local residents and a small percentage increase (estimated as less than five per cent) in the existing consumer output level in South Kohala and Hamakua as a result of the temporary construction period. A short-term increase in housing demand in Waimea and South Kohala will result. The small number of new jobs created and the small increase in consumer output may decrease the influence of agriculture (and accompanying wages) as the dominating industry in South Kohala and Hamakua on a small scale and for a short period. The 4.1 per cent unemployment rate in South Kohala will decrease somewhat during that period.

Industrial activity will increase on a small scale, particularly in construction related industries. Requirements for imported materials and equipment may serve to accelerate development of the proposed Kawaihae harbor and port.

5 - Power and Transportation

The Kohakohau Dam project will have a direct effect on the electric power system in South Kohala and Hamakua if potential hydroelectric facilities are incorporated. No substantive plans or decisions have been developed at this time, however, and the effects on power sources and rates cannot be predicted. No significant effect on transportation systems will result directly or indirectly from the project.

6 - Recreation

Although inclusion of recreational facilities in the Kohakohau Dam Project has been considered, the project as currently proposed will have no beneficial or adverse effect on the recreational facilities, uses, and potentials of the study area or the South Kohala-Hamakua region. The restricted status of the Kohala Watershed Reserve will not change.

7 - Aesthetic/Amenity Considerations

Although the natural visual character of 3,000 to 4,000 feet of the Kohakohau Stream system will be lost by inundation, present access to the area is so limited that no major effect on public awareness will occur. The project will have a small effect on visual conditions in South Kohala and the Waimea area. As shown in Figures 27 and 28, the puu's (hills) behind Waimea restrict view of the project area in nearly the entire vicinity of Waimea south to a distance of three or four

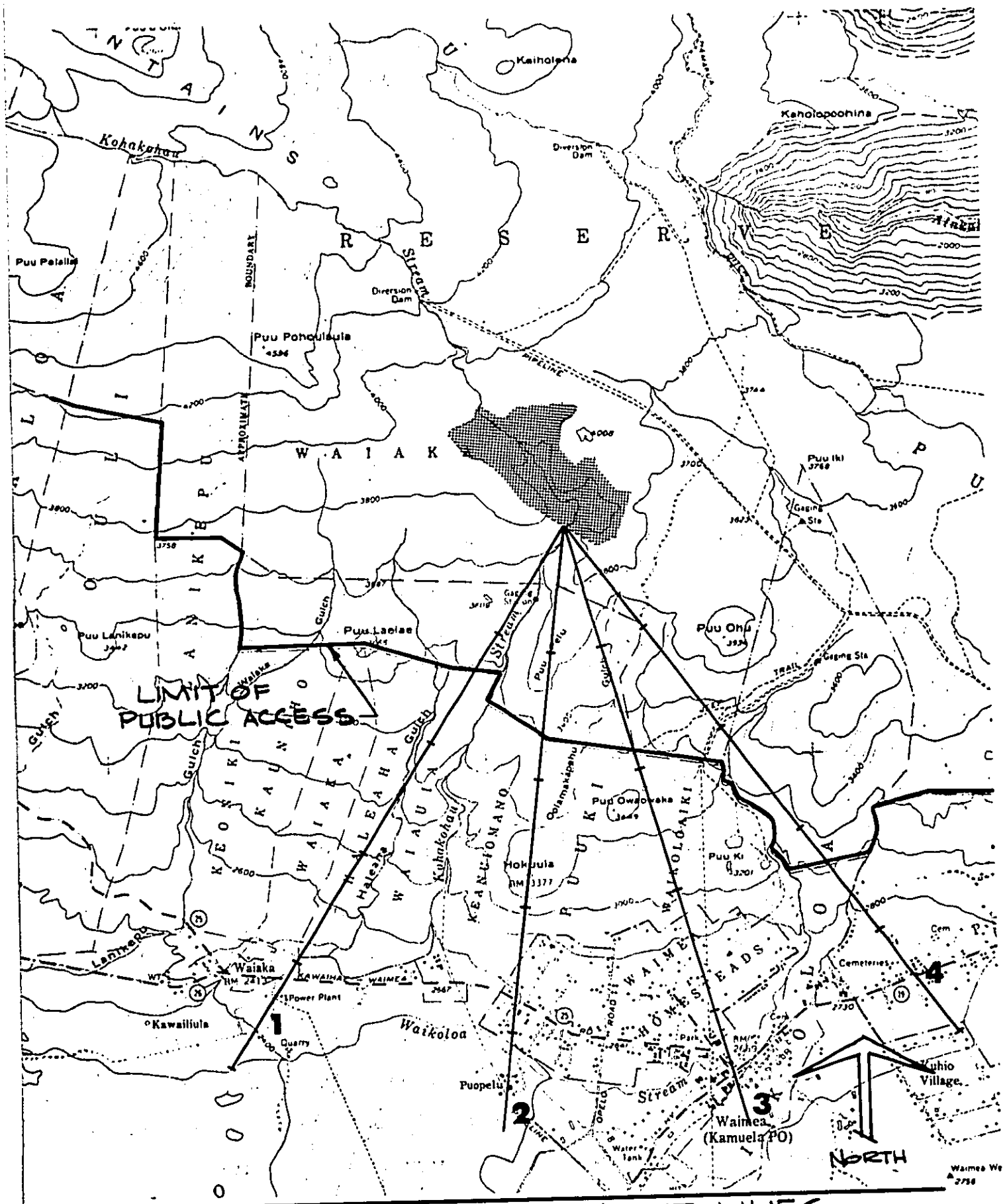


FIGURE: 27 STUDY AREA SIGHT LINES

KOHAKOHAU EIS - SOUTH
KOHALA DISTRICT, HAWAII

1000 0 1000 4000 FEET

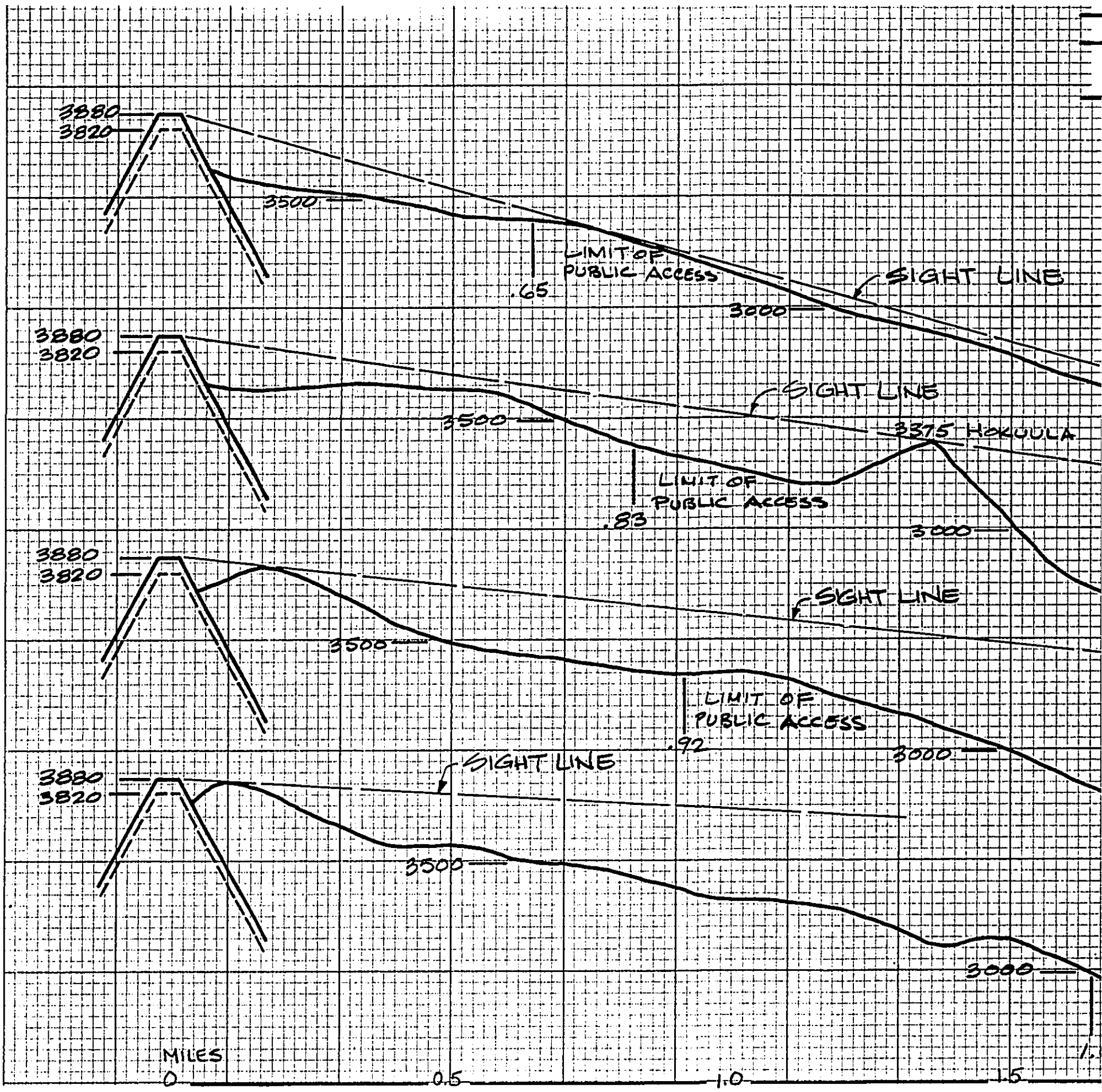
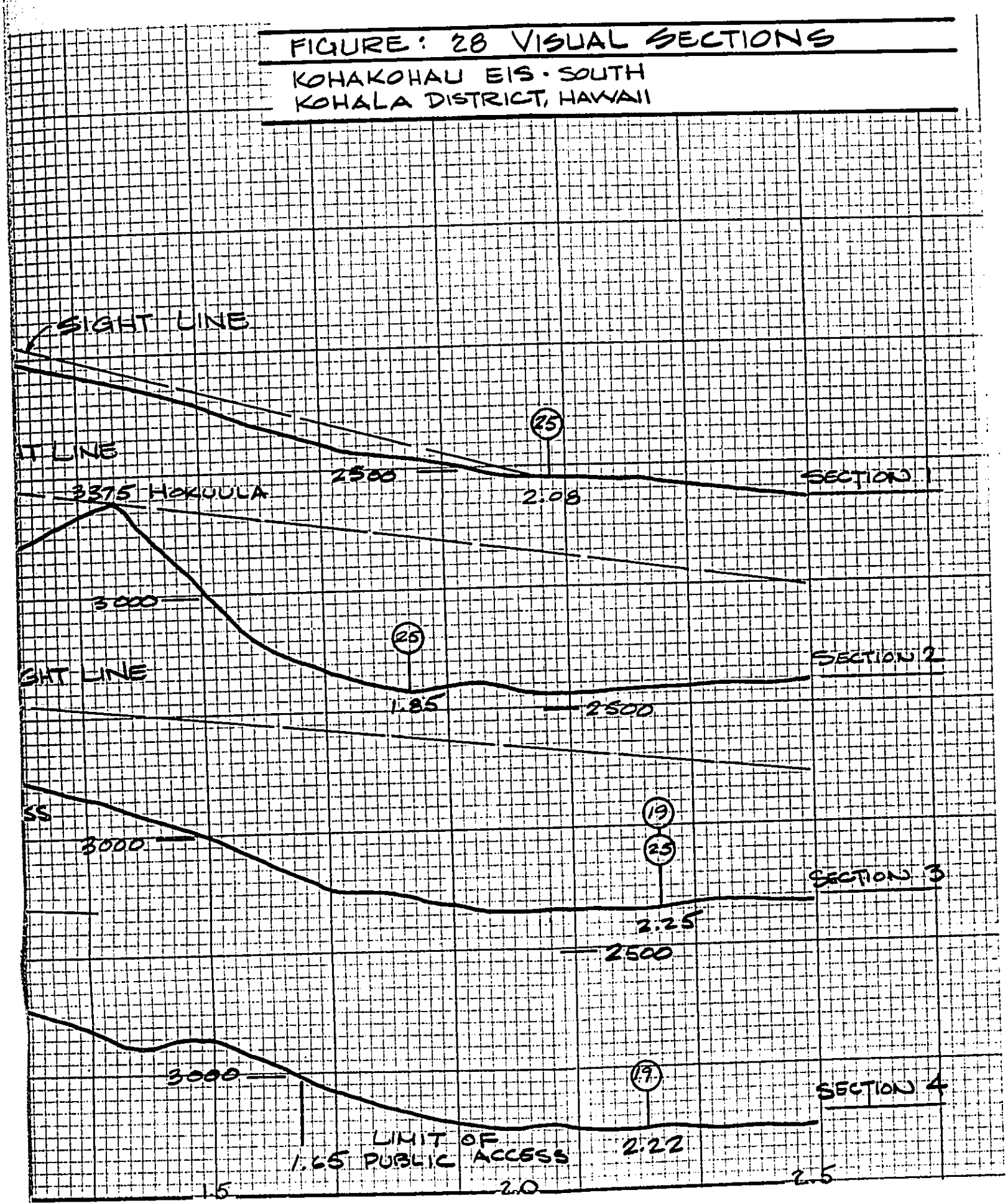

3880
3820
3500
.65
LIMIT OF PUBLIC ACCESS
SIGHT LINE
3000
3880
3820
SIGHT LINE
3500
3375 HOKUULA
LIMIT OF PUBLIC ACCESS
.83
3000
3880
3820
SIGHT LINE
3500
LIMIT OF PUBLIC ACCESS
.92
3000
3880
3820
SIGHT LINE
3500
3000
MILES
0
0.5
1.0
1.5

FIGURE: 28 VISUAL SECTIONS

KOHAKOHAU EIS · SOUTH
KOHALA DISTRICT, HAWAII



miles, and revegetation of the disturbed areas would not be discernable from that distance. The proposed primary dam would be visible from a small area near the Waimea power plant at a distance of about 2.5 miles (corresponding to Section 1 shown on Figures 27 and 28), which represents the greatest visual impact of proposed facilities to the Waimea area.

Flows in Kohakohau Stream below the project area are intermittent today and seldom reach the coastal plain much beyond the Waimea-Kawaihae Road except during flood incidents. Although flood discharges will be regulated by the dam and releases will be made whenever practicable, such releases are subject to natural losses in the stream system, and some overall reduction in streamflow, on an average annual basis, is expected below the project area. The effect of the dam and reservoir on the average number of low-flow days in the Kohakohau Stream system cannot be precisely predicted, but it is expected that the number of days in the year when there is no flow or low flow in the stream below the project area will not be appreciably increased. The importance and desirability of maintaining stream flow, when practical and depending on water availability, is recognized by the Division of Water and Land Development. Hence, during the operational management of the project, the importance of the visual and aesthetic aspects by providing flow, when practical, will become an operational criterion.

Construction activities will temporarily change, in some measure, the natural remoteness and tranquility of the Waimea town area.

PRIMARY AND SECONDARY IMPACTS: PHYSICAL

8 - Topography, Geology, and Soils

General topographic and subsurface conditions will not be affected by the Kohakohau Dam Project. Surface conditions will, however, be disturbed in the five Sub-Areas shown on Figure 14. The total estimated area disturbed in the ultimate development alternative is 200 acres; in the initial development alternative 150 acres. No mineral resources will be affected by the project other than construction materials. An estimated 500,000 to 1 million cubic yards of rock and borrow materials will be required for the dam structures, resulting in the excavation of Sub-Area 5 to a depth varying from 0 to nearly 20 feet in specific locations.

Intermittant erosion and siltation during high run-off periods, although infrequent and not serious below the dam-site location, will be remedied in the long term by the impoundment. During construction, however, increases in erosion and siltation will occur in disturbed areas.

As the project would be located in a seismically active area comparable in earthquake hazard potential to Southern California, criteria used in analysis of stability of the dam were generally adopted from the design practice of the California Department of Water Resources for the design of embankment dams for the State Water Project.

In the event of a strong earthquake, a slight readjustment of the rockfill will be experienced in the dam. In the last few years the use of heavy vibrating rollers for compac-

ting rockfill has reduced settlement and cracking to relatively small amounts and essentially eliminated the membrane cracking problem. Use of reinforcing steel in the concrete membrane also helps to spread out cracking, reducing the potential for development of large cracks. An analysis of the stability of the dam was, however, made for the improbable event of large cracks developing in the membrane. The analysis indicated that following such cracking of the membrane, the rockfill will retain its integrity while passing the leakage from a full reservoir. The evaluations indicate that the Kohakohau Dam is safe under seismic loadings and that a severe leakage rate exceeding the flood of record and equal to the maximum probable flow of the stream will not displace the rockfill. Since the probable leakage from the reservoir under the most severe and least probable conditions (i.e., maximum potential earthquake with a full reservoir, resulting in settlement of the dam and cracking of the impervious concrete membrane) is no greater than the maximum probable flow of Kohakahau Stream which can be contained by the downstream channel, the impact of the Kohakohau Dam Project on the downstream hazard is slight.

9 - Climatology, Air, and Noise

No significant changes in the micro-climate of the project area are expected, although small changes in winds and air currents, evaporation, and water temperature will occur in the reservoir vicinity. The Kohakohau Dam Project will, however, result in moderate short-term increases in air pollution and noise levels during construction. Emissions and noise from construction equipment will cause localized atmospheric disturbances in the immediate project area. These disturbances are not expected to significantly affect conditions in populated areas of Waimea and vicinity.

10 - Floral Features of the Ecosystem

Disturbances of existing vegetation in the project area will result from construction activities and new facilities as follows:

Sub-Area 1: Construction of the Upper Hamakua Ditch (UHD) Diversion will temporarily disturb the stunted and boggy vegetation in this area. Natural revegetation will occur after the channel is constructed.

Sub-Area 2: The impounded water and dam fill will inundate approximately 135 acres of mixed and disturbed vegetation in the ultimate development case or approximately 90 acres in the initial development stage. Trees, shrubs, and ground cover in this area are native and common species and typify a disturbed forest zone.

Sub-Area 3: The richest botanical zone in the entire project area occurs on the west slope of the Puu Pelu in this sub-area and will be disturbed to a small extent by potential access road locations. Other portions of the sub-area exhibit vegetation common to the entire project area both in variety and quality.

Sub-Area 4: Construction of the outlet pipe will temporarily disturb a strip along the Kohakohau Stream bed which exhibits vegetation like that of Sub-Area 2. Revegetation after construction will occur.

Sub-Area 5: Excavation for desired subsurface materials will damage surface vegetation in the approximately 40-acre area. Revegetation will be difficult in stripped areas.

No rare or endangered botanical species will be affected by the Kohakohau Dam Project. The most valuable zones of vegetation occur on the upper slopes in Sub-Area 5 and surrounding Sub-Area 2, and in Sub-Area 3 may be disturbed by peripheral construction activities.

11 - Faunal Features of the Ecosystem

The Kohakohau Dam Project will permanently remove approximately 90 or 135 acres (depending upon the development stage) of mixed endemic and introduced vegetation from wildlife support in Sub-Areas 2 and 3. This area presently supports primarily Japanese White-eyes, pigs, and pests which are common to all the islands. The upper slopes and ridges surrounding the damsite support larger numbers of endemic species and are more

valuable for preservation. No rare or endangered species of birds or mammals will be adversely affected by the project. Conversely, the reservoir area will provide an enhanced habitat for the endangered Koloa (Hawaiian duck).

The project will adversely affect no fish species, as none were identified in field surveys or are believed to exist in the Kohakohau Stream system.

12 - Surface Waters

Approximately 3,000 to 4,000 feet of the natural Kohakohau Stream bed will be inundated by the Kohakohau Dam Project. As is previously mentioned, flows in the Kohakohau Stream below the damsite will probably be reduced during filling of the reservoir and operation of the water supply system. At the same time, floodwaters will be impounded by the dam. Because Kohakohau Stream waters seldom reach the coast, if at all, no measurable effects on coastal waters will result from the project.

Water quality parameters will be affected by temporary increased erosion and sedimentation during construction of project facilities. Waters diverted at the Kohakohau Diversion below the damsite will be treated in existing facilities. No significant adverse effects will result from temporary increases in turbidity and suspended solid concentrations. A slight improvement in the long-term water quality of Kohakohau Stream waters is expected to result from impoundment, particularly in color and taste.

13 - Ground Water

Some seepage will occur from the reservoir and contribute to high-level ground water tables. The leakage will probably contribute to ground water occuring in dike compartments or in valleys on the northern slopes of the Kohala Mountains. The basal water table will not be affected by the project.

14 - Water Supplies and Demands

The Kohakohau Dam Project will provide an addition of 10 or 5 mgd (depending upon development alternative) to the estimated current total public domestic supply of 4 mgd in the South Kohala and Hamakua Districts. By mixing the fresh waters with brackish well-waters along the lee coast on a variable basis, the effective demand served by the project will be multiplied in those areas.

RANKING OF SIGNIFICANT IMPACTS

Table 11 presents a ranking of the impacts previously discussed. Beneficial and adverse impacts are shown. Magnitude and significance of expected impacts are considered in this ranking.

Table 11

Ranking of Significant Impacts

1. Provision of 5 or 10 mgd (depending upon development stage) to the domestic water supply in South Kohala and Hamakua.

2. Excavation in, and removal of 500,000 to 1 million cubic yards of material from, Sub-Area 5.

3. Reduction in average annual flows in Kohakohau Stream.

4. Provision of a new habitat for the endangered Koloa (Hawaiian duck).

5. Disturbance (inundation, stripping, construction) of about 150 to 200 acres of surface vegetation and soils, corresponding with initial and ultimate development alternatives.

6. Disturbance of primary vegetative and wildlife habitat areas on the west slope of Puu Pelu (Sub-Area 3) and the upper slopes and ridges surrounding the impoundment.

7. Permanent loss of visual quality of 3,000 to 4,000 feet of the Kohakohau Stream system by inundation.

8. Temporary increases in air and noise pollution levels in immediate project area during dam construction.

9. Adverse effect of dam structure on visual quality of southern slopes of Kohala Mountains.

10. Control of flooding and erosion from high runoff periods.

11. Temporary decrease in quality of Kohakohau Stream waters (increased turbidity, suspended solids) during dam construction.

12. Slight improvement in long-term quality of Kohakohau Stream waters.

13. Permanent removal of approximately 100 to 150 acres of land in the Kohala Forest and Watershed Reserves from the natural state (i.e., the "natural state" refers to the existing condition which exhibits some disturbances). Represents approximately one per cent of the total Kohala Forest Reserve acreage.

14. Temporary disturbance of tranquility in Waimea Town during dam construction.

15. Temporary increase in population in Waimea-South Kohala area during dam construction. Estimated as less than 5 per cent change in Waimea or less than 1 per cent change in South Kohala.

16. Temporary increase in employment and consumer output in Waimea-South Kohala area during dam construction. Estimated as less than 5 per cent change.

17. Slight acceleration in development trends in South Kohala-Hamakua region.

18. Potential provision of a new energy source in South Kohala and Hamakua by incorporation of hydroelectric facilities in the Kohakohau Dam Project.

19. Negligible increased hazard to downstream areas from failure of the dam in a seismic event.

V. MITIGATION AND RECOMMENDATIONS

In addition to the completion of comprehensive engineering studies (including geologic dam stability, structural, earthwork, diversion, and other analyses and designs) prior to construction of the Kohakohau Dam Project, other preventative and remedial measures can be incorporated in the planning, design, and construction of the project to mitigate many potential adverse impacts. Presented as follows are measures suggested to minimize adverse effects of impacts identified in Table 11.

1. No mitigation required.
2. Stripped and excavated areas should be regraded and should be replanted with native species of local vegetational populations or assisted in revegetating with such species.
3. Periodic and steady releases from the impoundment will minimize adverse effects of streamflow reduction below the damsite; however, a net decrease in streamflow is unavoidable.
4. No mitigation required.
5. Areas devoted to new facilities in Sub-Areas 1 through 4 should be revegetated, wherever possible, after construction. A slight visual impact of new facilities is considered unavoidable.
6. Disturbances of the upper ridges and slopes in the project area (Sub-Areas 2, 3, and 5) should be minimized and avoided, if at all possible, during construction. Access routes should be located strictly within

the zone of ununda tion (Sub-Area 2) and should not extend above the ultimate water level.

7. The inundation of 3,000 to 4,000 feet of the Kohakohau Stream bed is unavoidable.

8. It is not expected that increased air and noise pollution in the immediate project area will affect nearby residents. However, construction specifications should require the use of air and noise pollution-reducing equipment for the safety of workers and the assurance that no outside areas will be affected.

9. The southern side of the primary and saddle dams should be planted with suitable vegetation to reduce the adverse visual impact. A slight adverse impact is considered unavoidable.

10. No mitigation required.

11. Temporary water quality degradation can be minimized by controlling runoff from areas distrubed by construction activities. Streamwaters should be diverted around excavation areas, and sedimentation basins can be employed to remove suspended materials. A slight increase in turbidity and suspended solids is considered unavoidable.

12. No mitigation required.

13. The change of about 100 to 150 acres of land from the previous natural condition is unavoidable.

14. No mitigation required; the significance of a change in the existing social nature of Waimea Town is a subjective judgement.

15. No mitigation required.

16. No mitigation required.

17. No mitigation required.

18. No mitigation required.

19. Comprehensive planning, design, and construction measures appropriate to the Zone III seismicity classification of the area will reduce the potential hazard of flooding during a seismic event to a level resulting in no appreciable damage to downstream areas. Investigation of the use of a rubber membrane to complement the concrete dam surface membrane is encouraged in the design of the dam structures. Some success has been reported in the use of rubber membranes to reduce leakage from reservoirs and to provide added protection against erosion and leakage through cracks in the concrete membrane caused by readjustment of rock fill in a seismic event.

VI. UNAVOIDABLE ADVERSE IMPACTS

Table 12 summarizes the adverse impacts expected to be unavoidable with available and suggested preventative and remedial measures.

Table 12

Unavoidable Adverse Impacts

1. The expected decrease in streamflow below the damsite is considered a moderate impact, as existing diversions already have reduced flows to minimal or nonexistent levels.

2. Stripping and excavation for construction materials in Sub-Area 5 is considered a moderate impact, as the area is not clearly visible from publicly accessible areas and revegetation will occur.

3. The resulting visual impact of the dam structures is considered slight.

4. The resulting visual impact of new facilities in Sub-Areas 1 through 4 is considered slight, as access to these areas is severely restricted.

5. Inundation of 3,000 to 4,000 feet of the Kohakohau Stream bed is considered a moderate impact, as access to the stream is severely restricted.

6. Disturbance of the natural (previous) condition of about 150 to 200 acres of land is considered a slight impact, as the gross project area is already disturbed in many cases and natural revegetation will occur.

7. The temporary decrease in quality of stream waters below the project area is considered a slight impact.

8. The permanent change of 100 to 150 acres of land in the Kohala Forest and Watershed Reserves from the previous condition to accessory uses is considered a slight impact, as the accessory uses will promote the intended objective of the water supply watershed, and the area represents less than one percent of the total acreage of the Kohala Forest Reserve.

VII. SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Short-term uses of the study area environment will include tapping of surface water resources for domestic water supply purposes and devotion of surface areas for storage and transmission facilities. Benefits realized by the present generation will remain intact for future generations. Short and long-term productivities of the affected areas will not be changed from the current state of restricted conservation land use unless (1) recreational facilities are incorporated in the project, or (2) the restricted status of the area is changed in the future. Benefits accrued from the increased water supply, flooding control, increased Koloa habitat, and potential hydroelectric power generation are permanent returns from the proposed change in the nature of the study area.

VIII. IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

Approximately 90 or 135 acres (depending upon development alternative) of mixed native and introduced vegetation and wildlife habitat and 3,000 to 4,000 feet of natural stream bed will be lost by inundation of the reservoir and filling for the dam structures. Future reclamation of these resources, if desired, would be virtually impossible. Excavation of quarry materials in Sub Area 5 will permanently alter the subsurface characteristics of the area; however, future compatible uses would not be prevented. Construction of facilities in the other areas will commit the land surface to proposed uses; however, these commitments will not be irretrievable.

Commitment of surface waters to water supply uses will not be irreversible.

Commitments of raw materials, excavation, and labor in construction of the project are considered permanent.

IX. ALTERNATIVES TO THE KOHAKOHAU DAM PROJECT

In order to investigate and evaluate all options and possibilities in meeting the objectives of the proposed Kohakohau Dam Project, other water development alternatives considered to have potential feasibility were evaluated in terms of relative engineering, economic, and environmental aspects. Some schemes were suggested in the past; others were considered for the first time in this study.

The five alternatives identified were: (1) high-level ground water, (2) low-level ground water, (3) surface water, (4) desalination and (5) successive use of existing water supplies. Major criteria used in the evaluation of alternatives were the expected available water yield, the engineering and economic feasibilities of developing the source, and expected environmental effects. In addition, the alternative of no action was addressed. Each of these alternatives is discussed as follows.

1 - High-Level Ground Water

A - Engineering Feasibility

As has been previously discussed, it is suspected that a substantial quantity of high-level ground water may be stored in dike compartments on the southern slopes of Kohala Mountain. Tunneling for these suspected sources has been suggested in the past, as early as the 1940's. 47/ Although it is assumed that the sustained quantity of dike-confined water varies inversely with elevation (i.e., decreasing quantities of water would be expected to occur with increasing elevation), the suspected compartments are discontinuous and cannot be located without preliminary test borings. In addition, the reliable yield of a dike compartment can be determined accurately only by testing. Tunneling and drilling for potential high-level, dike-confined ground water is therefore limited in feasibility and practicality. In the vicinity of Waimea, test borings encountered no confined water to a depth approaching the 2,000 foot elevation level.

The alternative of multiple uses of a high-level tunnel to intersect potential dike-confined ground water compartments and transport surface waters pumped from below the lower Hamakua Ditch in Waipio Valley exhibits greater engineering feasibility, as the reliable quantity of available water in Waipio Valley is known.

47/ Reference 23.

B - Economic Feasibility

Primary costs associated with development of high-level ground water sources include exploration, tunneling, and pumping costs. Since locations of reliable high-level ground water sources are not presently known, a significant, and perhaps prohibitive, expense would be incurred in the exploration of the Waimea vicinity for suitiable sources. Depending upon the elevations and quantities of sources indentified, if any, tunneling costs could be significantly higher than costs for developing similar supplies in the Kohakohau Dam Project. The cost of pumping waters from Waipio Valley to the elevation of a high-level tunnel would be prohibitive with the current and projected high power costs in the region.

C - Environmental Effects

Although the drilling of a tunnel for ground water development would reduce surface disturbances and visual impacts, supporting surface facilities and structures would be required and a substantial quantity of tunneling spoils would require disposal. Tapping of dike-confined ground water in the area north of Waimea could be expected to reduce by some measure the flows in seeps and springs in the windward valleys. The magnitude of this effect cannot be predicted. Construction of pumping facilities in Waipio Valley would result in a significant impact to the surface cover and visual quality of the steep valley slopes.

2 - Low-Level Ground Water

A - Engineering Feasibility

Basal ground water is presently tapped in numerous locations in South Kohala, and the qualities of waters obtained vary considerably. As is previously discussed, the influence of saltwater intrusion is diminished with increased distance from the coastline; however, pumping requirements increase with higher elevations. The two existing Boise-Cascade wells drilled at about elevation 1,200 feet, yield unusually high quality water (about 20 to 30 ppm chlorides) with a reliable supply of 2 mgd. Since the precise areal extents of the aquifer and recharge basin supplying these wells are not known, extensive exploration would be required to determine the total yield available. It is considered unlikely that a supply comparable in quantity to the identified resource available in the Kohakohau Stream exists in the Boise-Cascade aquifer. Greater quantities of basal water are available farther inland; however, pumping lift requirements rise generally in proportion to distance from the coastline.

B - Economic Feasibility

Primary costs associated with development of low-level groundwater include well-drilling and pumping costs. With high power rates in the area, pumping of basal water to the approximate 2,600 foot elevation of Waimea is considered

prohibitively expensive in any potential development scheme.

C - Environmental Effects

Although the drilling and pumping of wells for domestic water supplies results initially in reduced surface disturbances and visual impacts, supporting facilities and transmission structures would be required, particularly where well waters would be pumped overland from the well location to the Waimea area. Depletion of the fresh water aquifer and the fresh basal lens could occur if the expected sustained yield did not meet demands.

3 - Surface Water

A - Engineering Feasibility

Large quantities of water are lost to the sea from seeps, springs, and dikes in Waipio Valley. Below the existing Lower Hamakua Ditch (approximate elevation 1,000 feet) a source could be developed in a quantity equal to the Kohakohau Stream supply; however, the minimum pumping lift would be nearly 3,000 feet to a point on the southern and eastern slopes of Kohala Mountain from which gravity flow would feed the Waimea area.

B - Economic Feasibility

Primary costs associated with development of Waipio Valley waters are comparable to the costs discussed in Alternative No. 1. The cost of a high-level tunnel would be replaced by an additional pumping requirement. High power rates would make the cost of pumping nearly 3,000 feet prohibitive.

C - Environmental Effects

Construction of pipelines would affect a strip approximately 4 to 6 miles in length, and large pumping facilities would be required in Waipio Valley. Access problems during construction could be expected to result in disturbance of a much larger total area.

4 - Desalination

A - Engineering Feasibility

Desalination of brackish ground water has been considered a potential alternative to surface and fresh ground water developments for some time. A current study by the Division of Water and Land Development is investigating the feasibility of desalination installations in Hawaii, and has identified the Kiholo - Puako area (along the coast south of Kawaihae) as one of two sites in the islands to receive detailed study.

B - Economic Feasibility

Since desalination requires large amounts of energy to effect the process of salt removal, high power rates in West Hawaii are expected to restrict the economic feasibility of a desalination plant providing a supply comparable to the Kohakohau Dam Project yield. In addition, pumping of treated waters to the Waimea area would be prohibitively expensive.

C - Environmental Effects

Principal environmental considerations would include the location and layout of such an installation, the physical and chemical natures of effluents and waste products, and the locations of effluent discharge points. Other effects would have to be considered if nuclear power was used in place of existing power sources in the study area.

5 - Successive Use of Existing Waters

Successive use (i.e., treatment of domestic or irrigation watewaters to levels suitable for domestic or lower uses) has been considered feasible in many highly-populated mainland areas where fresh water supplies are limited and wastewater flows are great. By collecting and treating domestic and agricultural wastewaters to levels suitable for irrigation and industrial uses, the initial demands for fresh water supplies can be dramatically reduced. In South Kohala and Hamakua, however, no centralized domestic or agricultural collection and treatment systems exist in already developed areas. New residential developments are being required to incorporate sewage collection and treatment systems, and it is possible that treatment of domestic wastewater for irrigation or industrial uses may become feasible in the future, primarily along the coastal strip expected to see large developments. In the short term, reclamation of waters in a quantity comparable to the yield of the Kohakohau Dam Project is unrealistic. Successive use of existing waters in the South Kohala-Hamakua region is therefore dismissed as a viable alternative to the Kohakohau Dam Project at this time.

Conservation of all natural resources and reclamation of wastewater supplies are, however, to be encouraged as a part of any water development plan to minimize depletion of remaining supplies and to optimize benefits from those resources tapped. Economies of scale realized in future urban developments in

South Kohala may provide the base for implementation of programs for successive use and conservation of presently developed water supplies.

6 - No Action

Effects of a decision not to implement the Kohakohau Dam Project cannot be assessed precisely because future development and growth patterns in South Kohala and Hamakua cannot be accurately predicted. Figure 26 and the accompanying discussion of projected water sources and demands indicate that existing and planned supplies (other than the Kohakohau Dam impoundment) may be sufficient to meet future demands for 1 to 5 years. Beyond that time, however, some new source of fresh waters would have to be developed. Any major change in land use and development patterns could shift that time frame significantly. In addition to base water demands, periodic droughts in the Waimea-Kawaihae area can be expected to further deplete water supplies unless new or back-up facilities are built.

Additional discussion of expected effects of the no-action alternative are presented for specific features in the section FUTURE ENVIRONMENT WITHOUT THE PROJECT. In summary, existing conditions would be expected to endure until a critical water shortage developed (perhaps in the near future). Beyond that time, existing and planned land uses in the South Kohala and parts of the Hamakua Districts could not be served.

In the short term, although a critical water shortage would not be expected to occur within a few years, planning for future developments as presented in the General Plan 48/ for the County of Hawaii would be impeded unless local sources

48/ Reference 6.

of water, either public or private, could be found and developed.

7 - Comparison and Summary

A- Engineering Considerations

Clearly the most practicable and reliable alternative from the standpoint of engineering feasibility is the Kohakohau Dam Project. The Waipio Valley surface water source is also reliable, but the large pumping lift imposes a significant design problem. Tunneling for suspected high-level ground water would require extensive preliminary explorations and might involve unknown constraints. The safe yield of the fresh water aquifer supplying the Boise-Cascade wells is not precisely known, and drilling for basal ground water above that elevation (approximately 1,200 feet) introduces a great pumping requirement.

B - Economic Considerations

With unknown and expected high costs associated with development of high-level ground water, prohibitive pumping costs associated with the surface water and basal ground water alternatives, prohibitive power costs expected with desalination, and the impracticality of successive use of wastewaters, the Kohakohau Dam Projects offers the most economical solution for the provision of additional domestic water supplies in South Kohala. The no-action alternative would lead to public or private development of incremental, localized water supplies, where available, which would be excessively expensive. No water would be provided in water-short areas.

It should additionally be noted that the possible incorporation of hydroelectric generating capacity in the Kohakohau Dam Project has the potential to recover some capital and operational costs. The magnitude of potential savings is undetermined at this time.

C - Environmental Considerations

Although the development of an underground water source (e.g., wells or tunnels to tap ground water) might exhibit an advantage over surface developments by limiting surface disturbances, unpredictable effects could include alteration of hydrologic and geologic balances and undesirable solid waste disposals. Construction of pumping facilities to develop Waipio Valley waters would result in severe surface disturbances. Impacts of desalination are unpredictable and depend in part upon processes used. The Kohakohau Dam Project is expected to result in minimal adverse impacts, as the project area is fairly remote and surface disturbances will be temporary.

D - Evaluation

Although other sources of fresh water are known and have been identified in the South Kohala-Hamakua region, the Kohakohau Dam Project offers the most advantageous and the preferable alternative for the provision of additional domestic waters in South Kohala and Hamakua from the standpoints of economic and environmental considerations. The unique potential

benefit of hydroelectric power generation associated with the Kohakohau Dam Project could be significant on the island of Hawaii, where energy production is generally limited to fuel-consuming installations.

X. AGENCY AND CITIZEN PARTICIPATION

1 - Contributions During the Environmental Impact Studies

During the course of environmental impact studies of the Kohakohau Dam Project, contacts were made with private citizens and groups and Federal, State and County governmental agencies to provide opportunities to participate in those analyses. Listed as follows are the groups, agencies, and individuals contacted.

A - Federal Agencies

1. Environmental Protection Agency (EPA)
2. Department of Interior, U.S. Geological Survey
3. U. S. Army, Corps of Engineers

B - Hawaii State Agencies

1. Department of Hawaiian Home Lands
2. Department of Health
3. Department of Land and Natural Resources, Fish and Game Division
4. Department of Land and Natural Resources, Forestry Division
5. Department of Land and Natural Resources, Land Management Division.
6. Department of Land and Natural Resources State Parks Division.
7. Department of Land and Natural Resources, Water Resources Regional Study
8. Office of the Governor, Office of Environmental Quality Control (OEQC)
9. University of Hawaii, Environmental Center
10. University of Hawaii, Water Resources Research Center
11. University of Hawaii, Hilo, Social Science Department
12. University of Hawaii, Manoa, Anthropology Department

C - County of Hawaii Agencies

1. Department of Planning
2. Department of Parks and Recreation

3. Department of Public Works

4. Department of Research and Development

5. Department of Water Supply

D - Citizens and Citizen Groups

Public Informational Meeting in Waimea, Hawaii, February 19, 1974.

Summary: An informational meeting was held at 7:30 P.M. in Kuhio Hall in Waimea and was attended by about 30 persons. Notice of the meeting was given through the Waimea-Kawaihae Community Association, the single body representing most residents of the area. An informational handout was distributed and views were exchanged during the meeting. Responses and comments primarily addressed aspects of local water sources and demands, land use and planning, dam safety and stability, protection of the Kohakohau Stream system, and releases from the proposed dam during development and operation.

Representative Questions and Comments:

1. Q: To whom will the impounded water go:

   A: Primarily to the Waimea, Honokaa, and Kawaihae-Puako areas.

2. Q: If a hotel is built behind Puako, where will its water come from?

   A: From the Kohakohau Reservoir, if constructed.

3. Q: How will downstream reaches of the Kohakohau Stream be affected?

A: There may be releases of waters during and after the stage of reservoir filling.

4. C: The 16-inch pipeline which takes water from the diversion dam on the Kohakohau Stream to feed the 50 million gallon storage reservoirs significantly affects the normal stream flow below that point. I would like to see an operation which catches only flood waters and allows the normal stream flow to pass.

5. Q: Is it possible to construct a reservoir in the drier areas toward Kawaihae and create a useable lake?

A: The geology of that area, the intermittant streamflows, and losses from evaporation limit the practicality of such a proposal.

6. C: The Kohakoahau stream environment, as a tropical stream system becoming a desert stream system, is perhaps unique from the standpoints of aesthetics and vegetation, and should be protected as such.

7. Q: Will the water from the Kohakohau Reservoir be supplied to the Kohala Estates area?

A: No.

8. C: The level of flow in Kohakoahau Stream used to be much higher than it is today or has been in the past 10-20 years.

9. Q: What is the chance that the dam would break and result in a catastrophe?

A: A rock-fill dam with a reinforced concrete surface membrane is much more flexible in an earthquake than is a more rigid structure. Earth or rock-fill dams normally fail only when flood waters erode the abutments. A detailed geologic safety and stability analysis would be completed in future design efforts.

10. Q: What is the possibility of tapping water in the Kohala Mountains as an alternative to the dam?

A: Such plans have been suggested in the past and will be considered in the E.I.S. Tunnelling for diked water is a gamble.

Public Informational Meeting in Waimea, Hawaii, June 13, 1974.

Summary: An informational meeting was held at 7:30 P.M. in the Waimea Elementary and Intermediate School and was attended by about 40 persons. Notice of the meeting was given in local news media and by letter to numerous community groups and associations in Waimea. An informational handout, summarizing the studies completed and preliminary conclusions, was distributed during the meeting. A presentation outlining the environmental impact study process, the technical studies completed, and the results obtained was given. Responses and questions primarily addressed aspects of streamflow maintenance, dam safety, and potential alternative water sources.

E - Historical Foundations and Conservation Groups

1. Bishop Museum
2. Conservation Council of Hawaii
3. Friends of the Earth
4. Hawaii Audubon Society
5. Kamuela Museum, Kamuela, Hawaii
6. Life of the Land
7. Sierra Club Foundation

F - Private Interests

No private interests were exclusively contacted during the environmental impact studies; however, notices of the public meetings held in February and June, 1974 in public media represented indirect contacts resulting in the expression of comments and concerns by private interests in the public meetings.

2 - Comments on the Draft Environmental Impact Statement

(To be completed)

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APPENDIX A. ANALYSES AND FIELD SURVEYS

Presented as follows are the complete consultants' reports on vegetation, wildlife, and aquatic life in the area of the proposed Kohakohau Dam Project. Reports on vegetation and wildlife address the potential project areas shown in Figures 29 and 30 (following pages 153 and 161). It should be noted that the potential riprap and borrow areas shown in those figures and discussed in the following reports on vegetation and wildlife have been rejected as unfavorable from environmental considerations. Figure 15 (following page 38) shows the area which will be considered for riprap materials to be used in the dam. Discussions of the existing environment and probable impacts to the environment presented in the main body of the report address conditions in that project sub-area only.

1 - Study of Flora

REPORT ON VEGETATION AND FLORA OF THE PROPOSED KOHAKOHAU DAM SITE, SOUTH KOHALA DISTRICT, HAWAII

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INTRODUCTION

This report has been prepared for Parsons Brinckerhoff - Hirota Associates according to the agreement entered into on February 5, 1974. The report is based upon a visit to the proposed Kohakohau Dam Site made on February 16-18, of that year. On these dates I hiked through the site to make general observations on the flora and vegetation of the area.

To my knowledge, no previous report which deals specifically with the botany of the dam site exists. However, several earlier publications mention briefly, in general terms, the vegetation of the Kohala Mountains.

W. T. Brigham (1868) states that "Mauna Kohála . . . is well wooded, and several trees grow there that are not found elsewhere on the islands, and some that grow only on Kauaì . . . at their bases, and on their slopes, the soil is often dry and barren." He also notes the presence of "crateriform marshes" and states that its summit "is swampy . . . and full of dangerous bog holes."

J. F. Rock, in July, 1909 and June, 1910, made several trips into the Kohala Mountains to collect botanical specimens. Unfortunately, Rock had almost total recall, hence whatever notes he made of his field trips are scimpy and incomplete. Judging from a map he sketched (Rock, 1909), he probably touched upon the lower limits of the potential borrow area (before it was put into forestry plantings), and he may have explored part of Puu Pelu (along the lower part of the access road and perhaps the extreme southern tip of the riprap area). However, his collections which may have come from these areas are listed merely as being from "the woods and swamps above Waimea, Hawaii" (Rock, 1910). Rock

(1913, later translated into the German, Rock, 1915) states that "It is only recently that this part of the land (the mountains of Kohala) was made accessible through the so-called upper Hamakua ditch trail, which leads to the headwaters of Kawainui gorge, opening to the botanist a most interesting field." Doubtless he was the first professional botanist in the area. C. Hitchcock, O. Degener, C. Forbes, F. R. Fosberg and others have since collected in the Kohala Mountains, but most appear to have followed the main jeep road to the higher elevations, where they did their work. It is doubtful if any collections were made, except along the jeep road, in the dam site. Rock states that "the vegetation is indeed rich, though inclined to be shruby" (Rock, 1909), and lists several plant species -- most of which were seen during my February visit. His is the best description of the area.

O. H. Selling (1948) briefly summarizes the literature concerning the Kohala Mountains. But, as he was interested in the pollen deposits of high elevation bogs, little is applicable to this report.

F. R. Fosberg (1961) produced a trail guide leading from Kailua, Kona, to the head of Alakahi Gorge. He lists the common plants seen along the main jeep road to the upper Hamakua Ditch.

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SUMMARY OF THE VEGETATION

The following paragraphs briefly describe the present vegetation of the 400 plus acre proposed Kohakohau Dam Site. This information is the outcome of the observations made while hiking through the area. The routes taken while sampling the vegetation are denoted on map no. 1. The subdivisions of the dam site (sub-headings below) are recorded on the same map.

Reservoir

The proposed Kohakohau Reservoir lies in a middle elevation, wet forest. In general the vegetation can be characterized as a sparse growth of tree ferns, shrubs and stunted trees. The ground cover consists of a great number of species of ferns, grasses, sedges and herbs, the majority of which are weeds of wide distribution. The moss, Sphagnum palustre, is abundant, forming thick mats on the ground and hummocks at the bases of the trees.

The dominant trees are Metrosideros and Cheirodendron, two of the most common genera in our native forests. Along the steep banks of the Kohakohau Stream, which roughly bisects the reservoir site, there is a luxuriant stand of these trees, most reaching 25-30 feet in height. At the other extreme, those on the flat bottom land of the reservoir are sparse and stunted, while the ones growing on the slopes of the puus and ridges enclosing the area are somewhat intermediate in size and number.

Tree ferns and occasional small trees and shrubs grow throughout the area. These form a sparse understory along the banks of the stream; elsewhere they are usually about the same height as the Metrosideros

and Cheirodendron. The native Rubus, Vaccinium and two species of Myrsine are the most common shrubs and small trees. Less common are Coprosma, Ilex, Gouldia, Pelea and Clermontia.

The ground cover is comprised primarily of Sphagnum moss and exotic herbs. Pig damage in the area is quite extensive. The disturbance they have created and, I suspect, the seeds they have carried, have resulted in a nearly totally exotic groundcover vegetation. Ginger, probably washed down by the stream, forms a dense, rank growth along the streams' steep slopes. Weedy herbaceous plants and native and exotic grasses and sedges are found in and along the stream. An aquatic moss grows abundantly among the rocks in the stream bed. Juncus and clumps of grasses and sedges are common in the bottom lands of the reservoir where the ground is covered by a thick mat of Sphagnum. The slopes of the enclosing ridges have patches of Dicranopteris; other ferns are scattered throughout the area. Hilo grass is one of the main ground covers and is mixed with other grasses, sedges, Juncus, Hydrocotyle, Erechtites, Eupatorium, Veronica and other herbs. The wetter more protected areas have large patches of Sphagnum while Cuphea, Drymaria, Vaccinium berberifolium and Hypochoeris replaces the moss on barer, more exposed slopes. Polygonum is common in shallow, muddy pig "wallows."

To summarize: the trees and shrubs of the area are all native, but common species, while the ground cover consists primarily of Sphagnum and common weeds of disburbed areas.

Potential Riprap Area

The vegetation of the northeastern slope, following the axis of the saddle dam, is very similar to the slope vegetation described above. As

one approaches the top of the puu, the vegetation becomes denser and epiphytic species are much more common. The top of the puu is covered by a small patch of nearly pure native forest. Again the dominant trees are Metrosideros and Cheirodendron with occasional small trees and shrubs of Ilex, Gouldia, Vaccinium, Broussaisia, Pelea, Myrsine, Cyrtandra and Rubus. An occasional Freycinetia and Smilax vine may be seen. Epiphytes are common here: Astelia, Peperomia, Elaphoglossum, Adenophorus. The ground cover consists of about 50% litter and 50% mosses with an occasional clump of Elaphoglossum or Astelia. Descending the southeast ridge of the puu, dense stands of Dicronopteris, Eupatorium and other weedy species are soon encountered.

Potential Borrow Area

This area is covered with Forestry plantings; Cryptomeria is the main species.

Access Roads

After leaving the main jeep road, the access road passes through a narrow strip comprised primarily of exotic trees: Eucalyptus, Alnus, and Melaleuca with an occasional Metrosideros or Cheirodendron mixed in. Just after starting into the native Metrosideros-Cheirodendron forest, the road turns abruptly southward into a cleared pasture.

The right fork of the access road passes through the grassland and back into the riprap area. It first passes through a small Cryptomeria grove, then enters a native forest similar to that along the northern side of the area.

The left fork continues through the pasture, then along the west

slope of Puu Pelu to the axis of the proposed dam. The western slope of Puu Pelu supports the best native forest that I observed in the study site. As in the other parts of the area sampled, Metrosideros and Cheirodendron are the dominant trees. The shrub and small tree story is botanically richest here. Cyrtandra and Gouldia hillebrandii are included along with Ilex, Coprosma, Gouldia terminalis, Vaccinium, Cibotium and others. The ground may be bare or have a light litter cover or it may have a rich covering of native ferns, mosses, sedges or liverworts. Occasionally a small patch of exotic herbs is encountered. Dicranopteris covers the strip along the fence line in many places, and is common near the crest of the puu. The epiphytic flora is very rich: Ophioglossum and Psilotum complanatum are common as is Astelia, Elaphoglossum spp. and filmy ferns. Polypodium pellucidum is a common epiphytic and terrestrial species in this area, especially along the top of the steep bank of the stream.

Spillway

The spillway will descend the steep bank to the Kohakohau Stream from the western side of the proposed Kohakohau Dam axis. The vegetation of this area consists of a tall (± 40 feet), open Metrosideros and Cheirodendron forest. Cibotium is common and ginger, palm grass and some Eupatorium cover the lower part of the bank and line the stream.

Outlet Pipe

The outlet pipe will follow the Kohakohau Stream. The vegetation of the stream banks is described above.

Main Jeep Road

A jeep road from Waimea town skirts the western side of the potential

borrow area, passes between the borrow area and the potential riprap area and continues on to the Upper Hamakua Ditch and the head of the UHD diversion channel. The vegetation adjacent to and between the tire tracks is comprised almost entirely of exotic weedy species. In the study area, the road is lined with Alnus and Eucalyptus trees. Introduced weeds and a few common indigenous plants as Pennisetum, Paspalum conjugatum, P. urvillei, Eupatorium, Commelina, Geranium, Cuphea, Nephrolepis, Axonopus, clover and Carex are abundant both between and along the tracks. Dicranopteris frequently forms a buffer zone between the vegetation of the disturbed area and that of the native stand. Holcus, Axonopus and Sphagnum with Hypericum, Hydrocotyle and other low, boggy species become more common as one approaches the end of the road.

UHD Diversion Channel

The diversion channel passes through an open boggy region of low trees and shrubs. Stunted Metrosideros and Cheirodendron with Vaccinium calycinum, tree ferns, Clermontia and Styphelia are the dominant shrubs. Sphagnum moss covers the ground and forms humps around the bases of the shrubs. Disturbance, primarily by pigs, has allowed hilo grass, Juncus and other exotic weeds to gain a foothold in the area, and are now a very common component of the vegetation.

CONCLUSIONS

The vegetation of approximately 217 acres (53%) of the proposed Kohakohau Dam site will be completely and permanently destroyed by the construction of the dam and the subsequent inundation of the reservoir area. These are the shaded areas on map no. 1. The plants under the UHD diversion channel, spillway, outlet pipe and access roads, of course, also will be destroyed. The remainder of the site will be badly damaged by the construction activities and by the lanes of invasion opened by the construction of the new roads and channels. It all comes down to the fact that the vegetation of the entire site will be dealt a blow from which it probably never will recover.

Is the vegetation worth saving? I believe that all stands of Hawaii's unique native plants are of great value. However, what we have here is not a good example of native vegetation. For years it has been a buffer zone between cleared, planted pasture land and the bogs of Kohala. Forestry plantings have been made within the site. A jeep road passes through it. A lane for a pipeline was cleared along its northern side and a row of Eucalyptus was planted in the lane. Pig damage is extensive throughout the site. An introduced ornamental (ginger) has heavily infested the stream banks. It is indeed a sad example of a wet, middle elevation forest.

In general, the dominant arborescent vegetation consists of a sparse, stunted stand of Metrosideros and Cheirodendron trigynum trees. Metrosideros is the most abundant tree in the Hawaiian Islands, while Cheirodendron trigynum is a very common species found on all of the main islands except Kauai. The shrubs and small trees as Cibotium, Ilex, Vaccinium, Sadleria

and Gouldia are common on all or most of the main islands. To my knowledge, there are no varieties or forms of these species which are restricted to this small area or to its immediate environs. Some of the species, as the Cyrtandra, are endemic to the Island of Hawaii but are rather widespread throughout the island or throughout the Kohala Mountains. The native ferns, epiphytes and groundcovers are mostly rather common sorts. Actually, the groundcover consists primarily of weedy herbaceous plants, indicating the amount of disturbance which has occurred in the area.

I saw no taxon which is listed on the tentative rare and endangered species list for the state.

In other words, in my opinion, none of the native species that I observed is rare in the islands today. I doubt if the construction of the dam would cause any significant damage to the total island population of any of the species involved. If the dam is to be constructed, placing it in this particular site probably would cause the least amount of damage to the native vegetation.

Possible long term effects on the flora and vegetation of the area are difficult to assess. One immediate effect would be to push the buffer zone of mixed native and exotic species northward a half mile or so. As the area above the site has been disturbed by pipeline and flume construction in the past, and by pig damage, this would be a rather qualitative effect. The possible long term effects must be viewed in the light of various practical considerations that are not related to my specialty of systematic botany; care, planning and foresight for the whole South Kohala District should be employed in their implementation.

CHECKLIST OF THE VASCULAR PLANTS OF THE PROPOSED KOHAKOHAU DAM SITE, KOHALA, HAWAII

This checklist is based entirely upon my observations of February 16-18, 1974. A search of the Herbarium of the Bishop Museum, of the notebooks of botanists known to have done field work in the Kohala Mountains, and of specimen citations in various botanical monographs, has not revealed any collection with data specific enough to ascertain that it was collected within or about the 409 acres included in this study. J. F. Rock probably touched upon the lower limits of the potential borrow area and the access roads. O. Degener, F. R. Fosberg and others have traversed the main jeep road to the Upper Hamakua Ditch. None, however, have specifically cited specimens collected from the area which falls within the scope of this study.

As the primary objective of the study was to survey the proposed dam site and to sample the various plant associations, rather than to make an exhaustive search solely for plant species, the list is not to be considered complete. In many cases determinations at the specific level could not be made as no specimens were found with flowers or fruit. The list does not include trees planted by the Forestry Department.

The following information is included for each species:

1) Scientific name.

2) Common or Hawaiian name, when known.

3) Distributional range of the species. This is indicated by the following symbols:

E - taxon endemic to the Hawaiian Islands, i.e. occurring naturally nowhere else in the world.

I - indigenous, i.e. native to the Hawaiian Islands but also occurring naturally (without the aid of man) elsewhere.

X - taxon of deliberate or accidental introduction after the Western discovery of the Islands.

4) Relative abundance and approximate distribution within the study site. A subjective five-point scale is used to record this information. A species which was seen once, or perhaps two or three times at the most, is ranked "rare." At the other extreme, the few most common species are ranked "abundant." The progression of the scale is as follows:

Rare

Uncommon

Occasional

Common

Abundant

The distribution may be qualified if the plant was found to be restricted primarily to one place. Restriction may be due to environment, disturbance, dispersal mechanisms, etc. The rank is based entirely upon a comparison of the frequency with which a species occurs, as compared to all other species; within the study site. It does not denote, necessarily, the abundance of that particular species in the Hawaiian Islands.

The total area sampled is shown on map no. 1 and is referred to as "study site" or "proposed Kohakohou Dam Site" in the checklist.

Family assignments follow J. C. Willis, A Dictionary of the Flowering Plants and Ferns, 8th ed. All taxa are arranged alphabetically.

PTERIODOPHYTA

ASPIDIACEAE - Shieldfern Family

Dryopteris paleacea (Sw.) C. Chr. (lau-kahi) I

Uncommon; on Puu Pelu.

ASPLENIACEAE - Spleenwort Family

Asplenium lobulatum Mett. (pi'ipi'i-lau manamana) I

Occasional, mostly on Puu Pelu.

Asplenium sp.

Occasional, most frequently seen on reservoir site.

Asplenium sp.

Uncommon.

ATHYRIACEAE - Athyrium Family

Athyrium japonicum (Thunb.) Copel E

Common along jeep road.

Athyrium sandwichianum Presl. (ho'i'o) E

Occasional to locally common on Puu Pelu.

BLECHNACEAE - Blechnum Family

Sadleria spp. ('ama'uma'u, 'ama'u) E

Abundant.

DENNSTAEDTIACEAE - Dennstaedtia Family

Microlepia strigosa? (Thunb.) Presl. (palapalai) I

Occasional.

DICKSONIACEAE - Tree Fern Family

Cibotium chamissoi Kaulf. (hapu'u 'i'i) E

Occasional.

Cibotium splendens (Gaud.) Krajina (hapu'u) E

Common.

GLEICHENIACEAE - Gleichenia Family

Dicranopteris emarginata (Brack.) Robinson (hairy uluhe) E

Common.

Dicranopteris linearis (Burm. f.) Underw. (uluhe, false staghorn fern) I

Occasional to locally common.

Hicriopteris pinnata (G. Kunze) Ching (uluhe-lau-nui) I

Uncommon.

GRAMMITIDACEAE - Grammitis Family

Adenophorus haalilioanus (Brack.) K. A. Wilson E

Rare.

Adenophorus sarmentosus (Brack.) K. A. Wilson E

Uncommon.

Adenophorus tamariscinus Hook. & Grev. (wahine-noho-mauna) E

Uncommon to occasional.

Grammitis tenella Kaulf. (kolokolo) E

Uncommon.

Xiphopteris saffordii (Maxon) Copel. (kihi) E

Uncommon.

HYMENOPHYLLACEAE - Filmy Fern Family

Mecodium recurvum (Gaud.) Copel. ('ohi'a-ku) E

Common epiphyte especially in riprap area and on Puu Pelu.

Sphaerocionium lanceolatum (H. & A.) Copel. (palai-hinahina) E

Common epiphyte in riprap area and on Puu Pelu.

Vandenboschia cyrtotheca (Hillebr.) Copel. E

Uncommon; a few specimens noted in riprap area.

LINDSAEACEAE - Lindsaea Family

Sphenomeris chinensis (L.) Maxon ex Kramer (palapala'a) I

Occasional; in disburbed areas only.

LOMARIOPSIDACEAE - Lomariopsis Family

Elaphoglossum alatum Gaud. ('ekaha) E

Common, especially in riprap area and on Puu Pelu.

Elaphoglossum hirtum var. micans (Mett.) C. Chr. ('ekaha) E

Occasional, mainly on Puu Pelu.

Elaphoglossum pellucidum Gaud. ('ekaha) E

Rare; few specimens seen in riprap area.

LYCOPODIACEAE - Club Moss Family

Lycopodium cernuum L. (wawae'iole) I

Common.

Lycopodium venustulum Gaud. (wawae'iole) I

Uncommon to occasional around upper end of UHD diversional channel.

OLEANDRACEAE - Oleandra Family

Nephrolepis exaltata (L.) Schott (ni'ani'au, sword fern) I

Common along jeep road; uncommon elsewhere.

OPHIOGLOSSACEAE - Adder's Tongue Family

Ophioglossum pendulum subsp. falcatum (Presl) Clausen (puapua-moa) I

Common on west side of Puu Pelu; rare elsewhere.

POLYPODIACEAE - Polypody Family

Pleopeltis thunbergiana Kaulf. ('ekaha-'akolea) I

Uncommon.

Polypodium pellucidum Kaulf. ('ae) E

Occasional throughout area except for west side of Puu Pelu where the species was common.

PSILOTACEAE - Psilotum Family

Psilotum complanatum Sw. (moa) I

Occasional; common on west side of Puu Pelu.

THELYPTERIDACEAE - Thelypteris Family

Cyclosorus dentatus (Forsk.) Ching (pai'i'iha, downy wood fern) I

Uncommon.

Cyclosorus sandwicensis (Brack.) Copel. (ho'i'o-kula) E

Occasional in Puu Pelu area.

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Occasional in Puu Pelu area.

MONOCOTYLEDONAE

COMMELINACEAE - Spiderwort Family

Commelina diffusa Burm. f. (honohono, day flower) X

Uncommon weed along main jeep road.

CYPERACEAE - Sedge Family

Carex aff. alligata F. Boott (Hawaiian sedge) E

Common. As only the bare floral culms remained, I was not able to determine if it was indeed this species or the closely allied C. pluvia.

Cyperus brevifolius (Rottb.) Hassk. (kyllinga, kili'o'opu) X

Occasional throughout area; locally common in certain open areas.

Cyperus polystachus Rottb. I

Common along jeep road and in other disturbed areas; occasional elsewhere.

Cyperus sp.

Uncommon; flat bottom land of reservoir.

Cyperus sp.

Rare; on main jeep road.

Machaerina angustifolia (Gaud.) Koyama ('uki) I

Occasional to common near upper end of UHD diversional channel.

Machaerina mariscoides subsp. meyenii (Kunth) Koyama ('uki) I

Rare on Puu Pelu.

Uncinia uncinata (L. f.) Kuek. I

Rare on east slope of Puu Pelu, not seen elsewhere.

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Machaerina mariscoides subsp. meyenii (Kunth) Koyama ('uki) I

Rare on Puu Pelu.

Uncinia uncinata (L. f.) Kuek. I

Rare on east slope of Puu Pelu, not seen elsewhere.

GRAMINEAE - Grass Family

Andropogon virginicus L. (broomsedge) X

Rare in this area.

Axonopus compressus (Sw.) Beauv. (carpetgrass) X

Occasional to common along upper part of UHD diversional channel.

Deschampsia australis Nees ex Steud. E

Occasional to common at upper part of UHD diversional channel.

Holcus lanatus L. (velvetgrass, Yorkshire fog) X

Occasional at upper end of UHD diversional channel, in disturbed areas.

Isachne distichophylla Munro ex Hillebr. ('ohe, ma'ohe'ohe) E

Rare; single small colony seen on slope above Kohakohau Stream in inundation area.

Paspalum conjugatum Berg. (Hilo grass) X

Abundant.

Paspalum urvillei Steud. (vasey grass) X

Uncommon; only along jeep road.

Pennisetum cladestinum Hochst. ex Chiov. (kikuyu grass) X

Common along main jeep road.

Poa annua L. (annual bluegrass) X

Common along jeep road, uncommon elsewhere.

Sacciolepis indica (L.) Chase (glenwoodgrass) X

Common, especially in open, disturbed areas.

Setaria geniculata (Poir.) Beauv. (perennial foxtail) X

Occasional only along jeep road.

Setaria palmaefolia (Koen.) Stapf (palmgrass) X

Occasional throughout area.

JUNCACEAE - Rush Family

Juncus planifolius R. Br. X

Common in open, wet areas.

Juncus effusus? L. (Japanese mat rush) X

Uncommon; several large clumps seen, none in flower or fruit, but appear to be this species.

LILIACEAE - Lily Family

Astelia menziesiana Sm. (pa'iniu) E

Common; very common epiphyte on west side of Puu Pelu.

PANDANACEAE - Screw Pine Family

Freycinetia arborea Gaud. (ie'ie) E

Rare throughout most of area; occasional on Puu Pelu.

SMILACACEAE - Smilax Family

Smilax sandwicensis Kunth (hoi-kuahiwi, aka'awa) E

Uncommon; most plants on Puu Pelu.

ZINGIBERACEAE - Ginger Family

Hedychium sp. ('awapuhi) X

Abundant at upper end of UHD diversional channel and on steep banks of Kohakohau Stream; uncommon elsewhere. As the plant was not in flower, I could not determine if it was the common white or yellow ginger.

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DICOTYLEDONAE

APOCYNACEAE - Periwinkle Family

Alyxia olivaeformis Gaud. (maile) E

Uncommon in reservoir area to occasional in riprap area and on western slopes of Puu Pelu.

AQUIFOLIACEAE - Holly Family

Ilex anomala H. & A. (kawa'u) E

Occasional throughout entire study site.

ARALIACEAE - Ginseng Family

Cheirodendron trigynum (Gaud.) Heller (olapa, olapalapa) E

Second most abundant species of tree in the area.

Tetraplasandra sp. ('ohe) E

Rare; a single specimen seen near upper end of UHD diversion channel.

BORAGINACEAE - Heliotrope Family

Myosotis azorica H. C. Wats. ex Hook. (forget-me-not) X

Occasional along main jeep road.

CAMPANULACEAE - Bell Flower Family

Clermontia kohalae Rock ('oha-wai, 'oha, haha) E

Uncommon in entire area except along the UHD diversional channel where it becomes occasional. A single flowering plant was seen, but vegetatively all specimens appeared to belong to the same taxon.

Cyanea pilosa? Gray E

Rare, a single small colony was seen near UHD diversion channel at about 3880 feet (elevation). The plant was not in flower, but vegetatively it resembled C. pilosa.

Trematolobelia grandifolia (Rock?) Deg. E

Occasional along the UHD diversion channel; uncommon in the rest of the study site.

CARYOPHYLLACEAE - Pink Family

Drymaria cordata (L.) Willd. ex R. & S. (drymaria, pipili) X

Common in reservoir and disturbed areas.

COMPOSITAE - Sunflower Family

Erechtites valerianaefolia (Wolf) DC. X

Uncommon in open, more disturbed areas to rare in riprap area and on western slopes of Puu Pelu.

Eupatorium riparium Regel. (spreading mist flower) X

Abundant, especially in open areas.

Hypochoeris radicata L. (gosmore, hairy cats-ear) X

Occasional, mostly in open, disturbed places.

EPACRIDACEAE - Epacris Family

Styphelia tameiameiae (Cham.) F. Muell. (pukiawe) I

Occasional; mostly along UHD diversion channel.

ERICACEAE - Heath Family

Vaccinium berberifolium (Gray) Skottsb. (barbery-leaved 'ohelo) E

Uncommon.

Vaccinium calycinum Sm. ('ohelo-kau-la'au) E

Common throughout area, especially so along UHD diversion channel.

GERANIACEAE - Geranium Family

Geranium carolinianum L. (Carolina crane's bill) X

Occasional in open areas.

GESNERIACEAE - Gloxinia Family

Cyrtandra platyphylla var. membranacea? Rock E

Rare throughout all of area except Puu Pelu where it is occasional.

GUTTIFERAE - Mangosteen Family

Hypericum degeneri Fosb. X

Occasional in open disturbed places as along jeep road and trails.

HYDROCOTYLACEAE - Hydrocotyle Family

Hydrocotyle sibthorpioides var. oedipoda Degs. & Greenwell (thick-rooted hydrocotyle) X

Rare; seen only at upper end of UHD diversional channel.

Hydrocotyle verticillata Thunb. (marsh pennywort, pohe) X

Occasional throughout study site.

HYDRANGEACEAE - Hydrangea Family

Broussaisia arguta Gaud. (kanawao, nawao, pu'aha-nui) E

Uncommon to occasional on Puu Pelu.

LABIATAE - Mint Family

Stenogyne calaminthoides Gray E

Rare; a single specimen seen near upper end of UHD diversion channel.

LEGUMINOSAE - Bean Family

Lotus sp. X

Uncommon along main jeep road.

Trifolium repens L. (white clover) X

Occasional along main jeep road.

LYTHRACEAE - Loosestrife Family

Cuphea carthagenensis (Jacq.) MacBride (puakamoli, Colombian cuphea) X

Uncommon; in open, exposed place in reservoir and along jeep road.

MYRSINACEAE - Myrsine Family

Myrsine lessertiana A. DC. (kolea-lau-nui) E

Occasional throughout area.

Myrsine sandwicensis A. DC. (kolea-lau-li'i) E

Occasional.

MYRTACEAE - Myrtle Family

Metrosideros collina subsp. polymorpha (Gaud.) Rock ('ohi'a-lehua, lehua) E

Most abundant arborescent species of study area.

Psidium cattleianum Sabine (strawberry guava) X

Uncommon; no mature plants observed, but a few seedlings were noted on Puu Pelu.

PEPEROMIACEAE - Peperomia Family

Peperomia lilifolia C. DC. ('ala'ala-wai-nui) E

Rare; on west slope of Puu Pelu.

Peperomia hypoleuca? Miq. ('ala'ala-wai-nui) E

Occasional, mostly on Puu Pelu and in riprap area.

Peperomia sp. ('ala'ala-wai-nui) E

Uncommon in riprap area and on Puu Pelu.

POLYGONACEAE - Buckwheat Family

Polygonum glabrum Willd. (kamole, knotweed) X

Common, especially in muddy, pig-disturbed areas.

ROSACEAE - Rose Family

Rubus hawaiiensis Gray ('akala, 'akalakala) E

Occasional.

Rubus rosaefolius Sm. (thimbleberry) X

Uncommon on Puu Pelu.

RUBIACEAE - Coffee Family

Coprosma rhynchocarpa? Gray (pilo) E

Uncommon. None in flower or fruit, but had vegetative characteristics of this species.

Gouldia hillebrandii Fosb. (manono) E

Rare; on Puu Pelu.

Gouldia terminalis (H. & A.) Hillebr. (manono) E

Uncommon.

Sherardia arvensis L. (spurwort) X

Uncommon; along the main jeep road.

RUTACEAE - Citrus Family

Pelea clusiaefolia Gray (alani) E

Uncommon; most specimens seen in riprap area and on Puu Pelu.

SCROPHULARIACEAE - Figwort Family

Veronica arvensis L. (corn speedwell) X

Uncommon; mostly at upper end of UHD diversion channel.

Veronica serpyllifolia L. (thyme-leaved speedwell) X

Occasional.

URTICACEAE - Nettle Family

Pipturus sp. (mamaki, mamake) E

Rare; a plant or two seen in riprap area.

SUMMARY OF THE FLORA

One hundred four species were recorded during the sampling. Of these, 34 taxa were ferns, 27 were monocots and 43 were dicots. About 2/3 (66.3%) of the plants observed are native to the Hawaiian Islands. Endemic species represent about 49% of the total.

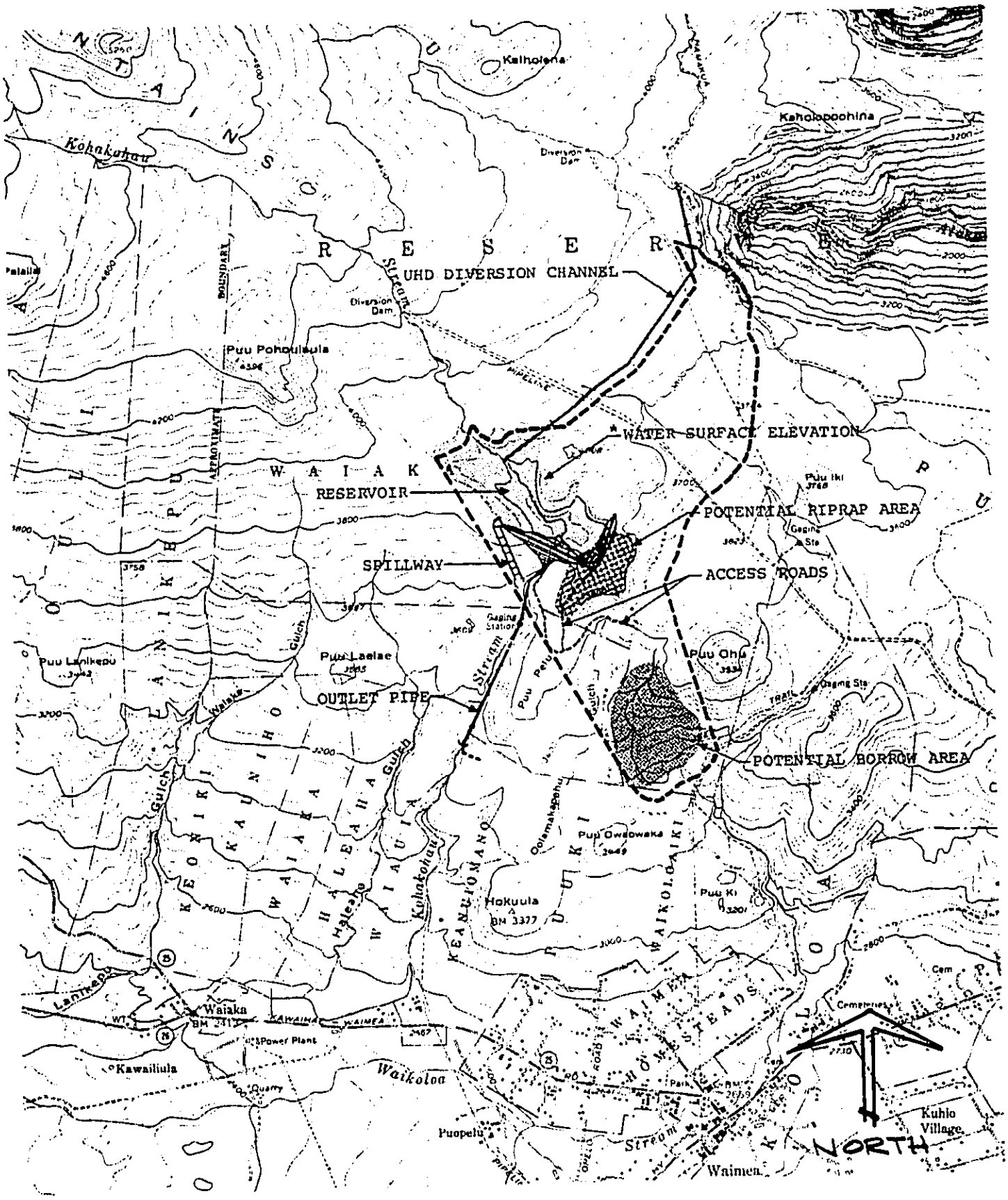

FIGURE: 29 STUDY AREA FOR VEGETATION SURVEY
KOHAKOHAU EIS - SOUTH
KOHALA DISTRICT, HAWAII

1000 0 1000 3000 FEET

2 - Study of Birds and Mammals

REPORT ON BIRDS AND MAMMALS OF THE PROPOSED KOHAKOHAU DAM SITE, SOUTH KOHALA, HAWAII

DR. C. ROBERT EDDINGER
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HONOLULU COMMUNTIY COLLEGE
HONOLULU, HAWAII

February 25, 1974

INTRODUCTION

The following report is the result of three days of intensive field work (February 16, 17, and 18, 1974) conducted by Dr. D. Herbst and myself in the area of the proposed Kohakohau Dam project, and a review of related literature.

I. THE STUDY SITE

The areas investigated in the study site are:

A. The acres (approximately 120) to be inundated by dammed waters, to elevation 3880 feet.

B. The potential riprap source area, comprising approximately 30 acres.

C. The potential borrow area, comprising approximately 70 acres.

D. Other areas included in the boundary of construction activities.

E. The 4000-foot strip along the proposed outlet pipe, from elevation 3620 feet to 3260 feet.

F. The 7000-foot strip along the proposed Upper Hamakua Ditch (UHD) Diversion Channel.

II. METHOD OF STUDY

Transects were walked throughout the first four mentioned areas. The inundated area was looked at in major detail and the borrow areas and construction areas also received considerable attention. The lengths of the UHD Diversion and Outlet pipe were hiked.

This study includes a checklist of the birds and mammals within the area, an indication of their relative

abundance, notes on whether they are endemic, indigeneous, or introduced, and estimates of the effects of the proposed project on their populations.

III. CHECKLIST OF BIRDS AND MAMMALS

A. Birds:

1. Apapane (Himatione sanguinea sanguinea). One race inhabits Hawaii, Maui, Lanai, Molokai, Oahu, and Kauai. This is the most common of the surviving species of Hawaiian Honeycreepers. Perkins (1903: 407) wrote that the Apapane once visited the coastal areas of the main islands. Today the Apapane is rare at elevations lower than 2,800 feet. The Apapane typically prefers trees that are at least 25 feet high.

2. Hawaii Amakihi (Loxops virens virens). This subspecies is endemic to the island of Hawaii; three other subspecies are endemic to Kauai (L. v. stejnegeri), Oahu (L. v. chloris), and Maui, Molokai, and Lanai (L. v. wilsoni). This is the second most common living honeycreeper. The Amakihi is abundant on Hawaii, Maui, and Kauai. Richardson and Bowles (1964) commented that "like the elepaio, the amakihi seems able to tolerate some vegetational or other human disturbances of the native forest." The Amakihi can thus be found feeding in forests of mixed endemic and introduced trees.

3. Hawaii Elepaio (Chasiempis sandwichensis sandwichensis). This subspecies is endemic to the island of Hawaii; two other subspecies are endemic to Oahu (C. s. gayi) and to Kauai (C. s. sclateri). Perkins (1893: 109) found the Elepaio to be one of the commonest birds in Kona, "extending its range from about 1400 feet to the limits of the proper forest on Mauna Loa, and also high up Hualalai." Like the Amakihi the Elepaio can be found feeding in forests of mixed endemic and introduced trees.

4. Koloa or Hawaiian Duck (Anas wyvilliana). This species was originally found on all of the main islands except Lanai and Kahoolawe. The Koloa became extinct on all of the islands except Kauai, probably as a result of the introduction of the mongoose. A propagation program at Pohakuloa has resulted in a number of pen-reared birds being released on Oahu and Hawaii.

5. Japanese White-eye (Zosterops japonica japonica). This species was imported from Japan in 1929 (Caum, 1933). This species has spread from Oahu to all of the inhabited islands. The White-eye can inhabit almost any habitat-type within the islands and is by far the most abundant bird, native or introduced, in the islands. There are as yet no studies on the relationships between the White-eyes and endemic birds. White-eyes may actually compete with our

endemic birds and they may be responsible for the spread of bird malaria.

6. Chinese Thrush (Garrulax canorus). This species was introduced to Oahu around 1900 and later to Molokai, Maui, Hawaii and Kauai. The Chinese Thrush prefers low dense vegetation and is at home in many introduced plant thickets. Ord (1967) said that the Chinese Thrush was "abundant on Hawaii, Maui, and Oahu, from 400 feet up to the tree limit."
7. Ring-necked Pheasant (Phasianus colchicus torquatus). The species was introduced as a game bird about 1865. The Ring-necked Pheasant prefers open grasslands.

B. Mammals:

1. Feral pig (Sus scrofa)
2. Black rat (Ratus rattus)
3. House mouse (Mus muculus)
4. Mongoose (Herpestes auropunctatus)

All of the mammals were introduced to Hawaii by man. The black rate and the mongoose are definite pests--both are often predators on birds and their eggs. In my study of native birds on Kauai the black rat was a major predator. The mongoose is a known predator on ground nesting birds and is probably responsible for the extinction of the Koloa on all of the islands except Kauai. Rats,

mice, and pigs may also carry diseases that can be transmitted to man. Pigs are also responsible for the destruction of some of our native ground cover. None of these species of mammals should be considered worth saving from an ecological viewpoint.

IV. WHAT WILL HAPPEN TO THE WILDLIFE AS A RESULT OF PROPOSED DAM CONSTRUCTION?

Refer to Section I for area descriptions.

A. The 120 acres to be inundated:

Apapane, Amakihi and Elepaio are very uncommon within the area to be inundated by the proposed Kohakohau Dam, largely because the vegetation is too scrubby. I found a few Apapane and Amakihi in the tall trees along Kohakohau Stream. These birds would probably relocate in the higher vegetation along the ridges. The most common birds in this area are Japanese White-eyes which we could very well do without. We did see two Koloa fly over this area but they did not alight within the area to be inundated. The construction of the dam may actually enhance this area for duck feeding and breeding.

B. and C. The 30 acres considered for potential riprap sources and the 70 acres considered for potential borrow sources:

These areas contain a mixture of endemic and introducted vegetation and correspondingly are inhabited by species that can tolerate disturbances. The Japanes White-eye is again the most common species, but Amakihi and

Elepaio also visit this area. A few Apapane come here to feed but the trees are not suitable for nesting. I heard several Chinese Thrush singing from within dense undergrowth in this area. One Ring-necked Pheasant was here but no doubt came from the nearby meadow where they are common. A disturbance in this area will delete some feeding areas for the three endemic passerines.

D. The remaining areas included in the outer boundary of construction activities: The ridges and high slopes that surround the construction area are the most vital areas to preserve as far as wildlife is concerned. It is here that Amakihi, Apapane, and Elepaio are quite abundant.

E. and F. The 400 foot strip along the proposed outlet pipe and the 7000 foot strip along the upper Hamakua Ditch. Both of these areas are very poor wildlife areas--inhabited mainly by Japanese White-eyes.

V. RECOMMENDATIONS

The area of greatest concern for wildlife preservation should be the upper slopes and ridges surrounding the dam. These areas are the richest areas in terms of abundance of endemic species, largely because of the height of the vegetation.

My investigations on Kauai have shown that the endemic Apapane, Amakihi and Elepaio are still common in disturbed areas, as round the Kalalau Lookout at Kokee, as long as the suitable native vegetation is preserved. I would therefore

encourage preservation of the larger native trees on the slopes and ridges surrounding the dam. We can have the dam and still have suitable wildlife areas for our native birds with the preservation of these slopes and ridges.

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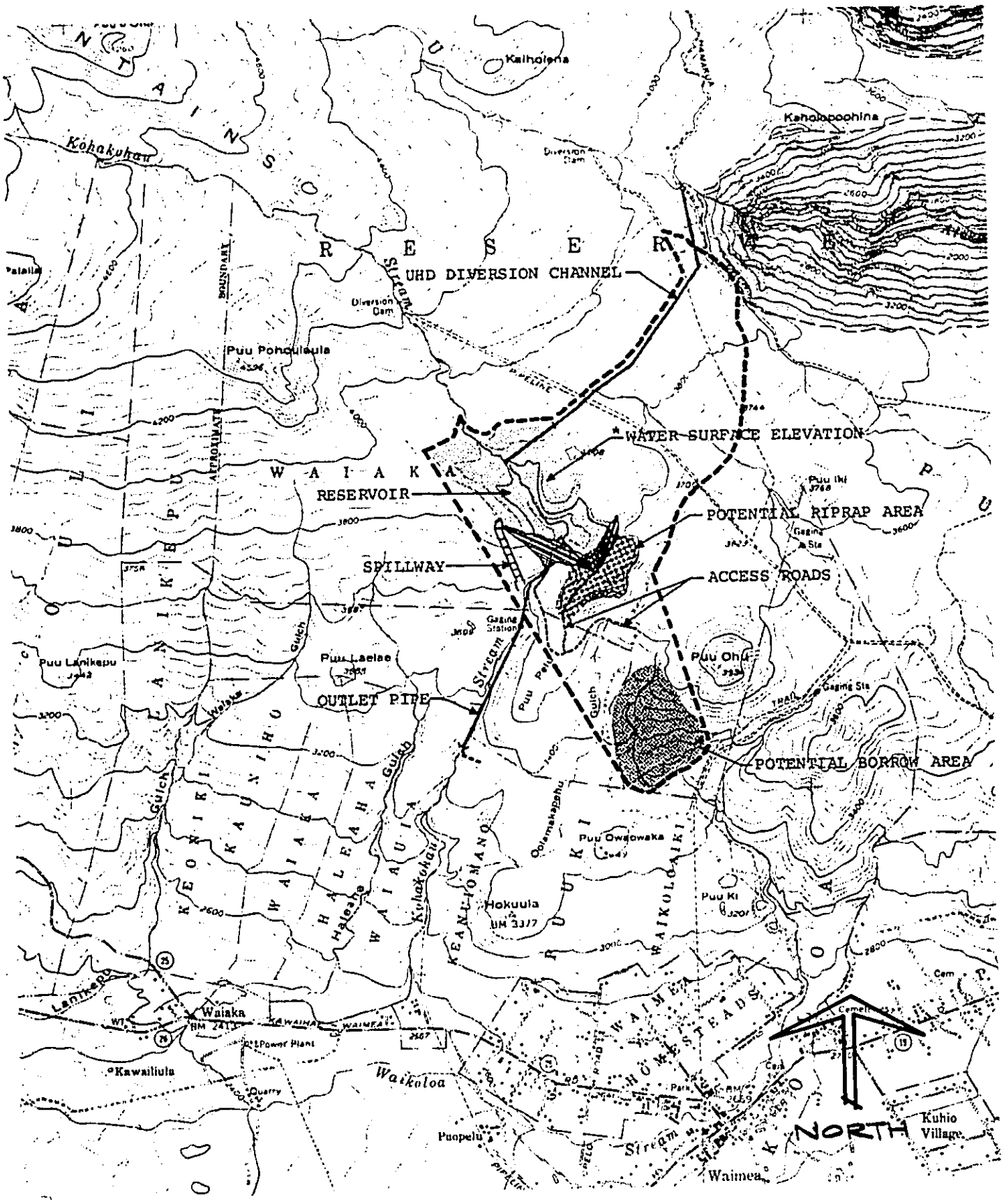

FIGURE: 30 STUDY AREA FOR FAUNAL SURVEY

KOHAKOHAU EIS-SOUTH
KOHALA DISTRICT, HAWAII

1000 0 1000 3000 FEET

3 - Study of Aquatic Life

JOHN A. BURNS
GOVERNOR OF HAWAII

DIVISIONS:
CONVEYANCES
FISH AND GAME
FORESTRY
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FISH AND GAME
1179 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

June 27, 1974

Mr. Robert T. Chuck
Manager-Chief Engineer
Division of Water and
Land Development
Department of Land and
Natural Resources

Dear Bob:

On March 20, 1974, George Matsumoto of your staff and Kenji Ego, Richard Yoshida and Stanley Shima of the Division of Fish and Game visited the proposed Kohakohau Dam and Reservoir Project site in Kohala, Hawaii, with the objective of evaluating potential environmental effects of the Project on fisheries values in the area. The following is our report on this activity, using the format recommended by your consultant.

* * * * * * * * * *

1. Previous Studies

We are not aware of any previous studies relating to fisheries values in the Project site.

2. Existing Environment.

The field survey was conducted between 1000 and 1130 hours on March 20, 1974. It should be noted that conditions were less than ideal for the observation and collection of aquatic life in that the stream was in a mild freshet stage at the time (USGS gaging station records show a peak flow of 217 cfs at 1630 hours on March 19, and a flow of 9.2 cfs at 1000 hours on March 20). Collecting materials included a fine-meshed seine and handnet, and a small quantity of rotenone. The use of face-masks for underwater observation was precluded by the turbid waters.

Collecting efforts were confined to a pool and riffles section located just mauka of the recommended dam site (Site 5 in the Feasibility Study). Repeated sets of the seine and use of the handnet, and poisoning of a very small pocket of water with rotenone resulted in the collection of only a few chironomid larvae, caddisfly larvae, damselfly nymphs and snails. No other aquatic fauna were collected or observed.

3. Probable Future Conditions without the Project.

We have no basis for expecting any changes in aquatic faunal conditions without the Project.

4. Impact on the Environment.

Creation of the impoundment will change approximately 3,000 to 4,000 feet of the Kohakohau Stream from a lotic to a lacustrine habitat for aquatic organisms. This change from a small free-flowing stream to a relatively large area of deep standing water will undoubtedly effect marked qualitative and quantitative alteration of the present aquatic faunal populations. From our perspective, however, this modification is not deemed to be significantly either detrimental or beneficial.

A potential benefit that may be realized from this Project is the development of a recreational fishery.

5. Mitigation and Recommendations.

In view of our comments in the first paragraph of the preceding section, and our understanding that the Kohakohau Stream is normally dry makai of the existing diversions, we do not feel that any measures for mitigation of damage to fisheries values are necessary.

Exploration of the feasibility of establishing a recreational fishery should be seriously pursued.

6. Unavoidable Adverse Impacts.

None, from our standpoint.

7. Sources Consulted.

Kohakohau Dam Engineering Feasibility study, February, 1970.

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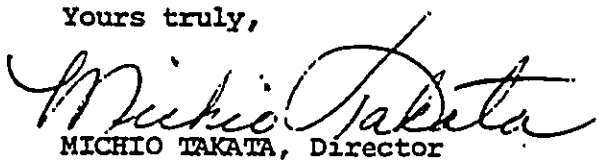
I trust that this report will suffice for your purposes. Otherwise, please let me know.

Yours truly,



MICHIO TAKATA, Director
Division of Fish & Game

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